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CONTENTS

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IN THIS ISSUE

In the current issue of the *Quarterly*, three papers are published which were read at the Round Table on "Backgrounds of Social Medicine," one of the sections of the Annual Conference of the Milbank Memorial Fund, held November 19–20, 1947. Four other papers were published in the January and April issues of the *Quarterly*. The articles in this issue are concerned with variations in mortality and morbidity rates among persons of differing environments, especially social and economic environment.

In the article on "Mortality and Socio-Environmental Factors" by Dorothy G. Wiehl, age and sex differences in mortality in various geographic areas of the United States are discussed, together with some of the broad implications of the current variations. Although death rates in all parts of the United States have declined sharply in the past half century, this decline has not been at a uniform rate. The decrease in death rates for children in rural areas has been less than that in cities, and the decrease in mortality of adult males has been less than that of females both in cities and rural areas. The wide differentials in mortality among various adult populations strongly suggest the importance of environmental factors, but the specific factors have not been identified.

The article "Social and Environmental Factors in Illness" by Jean Downes presents a review of some of the most recent data, drawn from various sources, which illustrate the breadth or the limits of our knowledge of the relationship of illness to various social and environmental conditions. Illness is considered in relation to the following factors: rural-urban migration, age, color, income, crowding, and chronic disease.

The third article in this series is "Physical Impairments and

Socio-Environmental Factors" by Rollo H. Britten. Data from surveys and from health examinations are reviewed by Mr. Britten. The relative prevalence of impairments, such as defects of vision and hearing, dental, and orthopedic defects, in populations of different socio-economic levels is considered. The prevalence of physical handicaps is consistently higher in the lowest economic groups. Physical disabilities are causes of low income, and the components of low economic status are causes of physical impairments, forming a vicious circle.

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The relation of long hours of work, particularly of a tedious and fatiguing character, to the health and efficiency of workers has been under investigation for many years. The article "Sickness Among Industrial Employees in Baltimore in Relation to Weekly Hours of Work" by Selwyn D. Collins is a unique contribution in this field of study. His analysis considers persons living in a certain area regardless of the place of work, and compares sickness rates for those working long hours with those working short hours. The period considered was January 1, 1941 to May, 1943.

Long-hour workers of each sex suffered more illness than did short-hour workers. This general picture was true for workers in both defense and nondefense plants. Minor respiratory attacks were consistently more frequent in the long than in the short-hour groups.

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Cancer strikes so many persons in the population today that the question "What can we do about cancer?" is being asked by the lay public as well as by the health and medical profession. In an article entitled "Public Health Aspects of Cancer Control," Savel Zimand, Director of Health Education of the New York City Cancer Committee, describes the measures which can and should be taken now in health campaigns against cancer. This disease is not preventable but early diagnosis and competent treatment can achieve significant results in preventing deaths.

MORTALITY AND SOCIO-ENVIRONMENTAL FACTORS

DOROTHY G. WIEHL[1]

THE association between physical environment and certain diseases was the foundation on which the public health program was built. Through the application of sanitary measures, through control of animal and insect vectors and of food contamination, and through protection of the individual against infectious organisms by immunization, public health brought about tremendous reductions in mortality. Continued progress in the battle to give more and more of the people the opportunity to live out the span of life attained by the healthiest or most fortunate members of society requires persistent study of the conditions which contribute to premature death. Sydenstricker (1), in HEALTH AND ENVIRONMENT, wrote "failure to survive in the early years of life may be ascribed chiefly to accidents of environment, to conditions of living and to ignorance, . . . in later years of life failure to survive is due chiefly to organic breakdowns." Successful control of environment, improved medical care, and advances in medical science have brought death rates in childhood to a level that is lower than the less optimistic dared to expect a few years ago, and very marked reductions in mortality of young adults. But in late middle life the decrease has been relatively small. Today, therefore, we are concerned with the problem of improving and widening our approach to the prevention or postponement of mortality and especially to the postponement of "organic breakdown." The effect of environmental factors on adult health is not well understood and there is need for more investigation of the possible relationship between early breakdown from the so-called degenerative diseases and such factors as mode of work, level of income and of education with their many related conditions, such as housing, nutrition, social and recreational activities, and concentration of populations.

The ideal method for studying effects of a specific environ-

[1] From the Milbank Memorial Fund, New York.

mental factor on mortality is to compare groups which differ with respect to that factor but are alike in other major respects. This is almost never possible. In fact, only rarely are mortality rates available for population groups that can be classified according to some one or two well-defined indices of environment. At present, therefore, our evidence concerning the effect of socio-environmental factors on mortality is based largely on deductions from variations in mortality by sex and age and for various causes in populations living in different sections of the country, under various degrees of urbanization, and, for persons living in large cities, variations among different sections of a city. These populations can be described as to some other characteristics such as proportions engaged in different types of occupations, the average income and educational status, but mortality rates specific for such breakdowns are not available. Obviously, such indirect evidence is only suggestive and subject to rather general inferences. Data of this type for the United States have been discussed in two books—one HEALTH AND ENVIRONMENT by Sydenstricker (1) and the other LENGTH OF LIFE by Dublin and Lotka (2), and in many articles. I shall not attempt to summarize these previous studies but shall limit myself to presenting some of the latest mortality data of this type.

Extensive data on mortality for whites and for nonwhites in the United States are available and the differences in mortality for these groups reflect very largely the results of the lower socio-economic levels of living of the Negroes, although some differences in mortality may possibly be due to racial characteristics. At least the evidence is clear that mortality of the Negroes is susceptible to reduction, and in the period from 1921 to 1940 the average annual per cent of decline in age-adjusted death rates for nonwhites (in 1940, 96 per cent of nonwhites were Negroes) was 1.59 compared with 1.43 for whites (3). Presumably the same factors are chiefly responsible for the improvement in mortality in both groups The age-adjusted death rate for nonwhites in 1940 was 16.25 per 1,000, which is 60

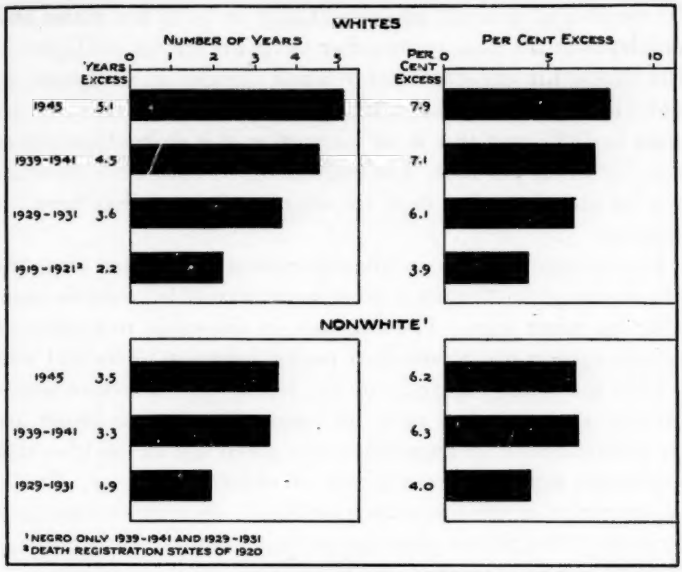

Fig. 1. Excess in expectation of life at birth for females as compared with males in the United States. Excess is shown in number of years and per cent for whites and nonwhites.

per cent higher than the rate of 10.16 for whites. It is not necessary to present evidence that the colored population on the average has a lower economic status than the white population, has poorer housing, less education, and has a generally less favorable standard of living. It is significant that from 1940 to 1945, when Negroes as well as whites had higher incomes than ever before, the mortality decline for Negroes was definitely accelerated. Life tables for 1945 (4) and for 1939–1941 (5) show that the expectation of life at birth increased 3.8 years for Negro males and 4.1 for Negro females. This increase in five years for males is 80 per cent of that for the previous ten-year period, and for females it is 68 per cent.

Differences in mortality trends for sex and age groups, as well as for whites and nonwhites are suggestive of the influence of environmental factors on mortality. The differences between

the number of years of life expectancy at birth for males and females over the past twenty-five years are shown in Figure 1. The excess life expectation for white females as compared to males increased from 2.2 years for the period 1919–1921 to 5.1 years in 1945, and this is an increase in the percentage excess from 3.9 to 7.9 per cent. For nonwhites the excess life expectation for females is less than for whites but it too has been increasing.

The greater increase in life expectancy for women than for men is due almost entirely to a more favorable trend in mortality at adult ages. The decrease in life-table mortality at specific ages in the fifteen-year period between 1929–1931 and 1945 is shown in Figure 2 for the white and nonwhite populations. The mortality rates on which this chart is based are the percentages of persons alive at a given age in the life-table population dying before reaching an older specific age. In the upper section of the chart, the percentage decrease in mortality for each of five fifteen-year age periods between birth and age 75 years has been plotted.

Under 15 years of age, the decrease in mortality by sex differs only slightly for both whites and nonwhites. But after age 15 years, the greater percentage decrease in mortality among females is very striking, especially for the white population. Between ages 15 to 30 years, the death rate for white females in 1945 was 59 per cent lower than in 1929–1931 and for white males, the rate declined 44 per cent in the same period; similarly at ages 45 to 60 years, the reduction in mortality was 28 and 10 per cent for females and males, respectively. Thus, the widening difference in expectation of life between males and females is the result of factors operative in adult life, both for Negroes and whites.

It is of interest that in this fifteen-year period the maximum percentage reduction in mortality occured between ages 15 and 30 years for each sex and color group, although for white males the difference between this age group and the age group under 15 years is negligible. This relatively high reduction in early

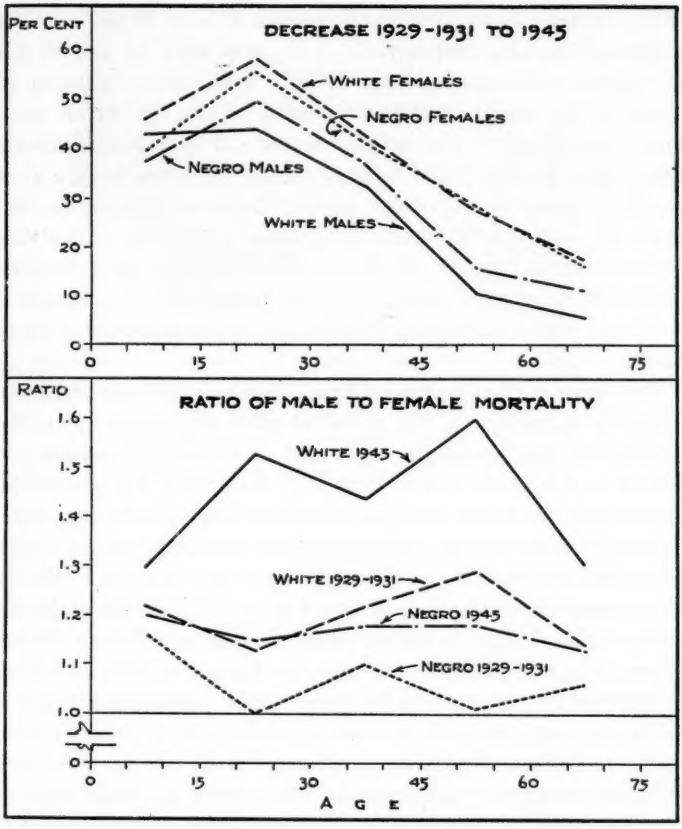

Fig. 2. Per cent decrease in percentage of life-table population dying in five fifteen-year age intervals between birth and age 75 years between 1929–1931 and 1945; and ratios of male to female percentages dying in these age intervals at each period.

adult life represents a marked increase in the rate of decline at this age period. For example, comparison of life-table mortality for Death Registration States of 1900 for the ten-year period 1901–1910 with that for the Death Registration States of 1920 for the ten years from 1920–1929 (6) shows that in the twenty-year interval between these life tables, mortality for

whites at ages 15 to 30 years decreased 33 and 30 per cent for males and females, respectively, compared with 44 and 58 per cent in the recent period from 1930 to 1945. At ages under 15 years, in the earlier twenty-year interval the decline in mortality was 43 and 46 per cent for males and females and, therefore, much greater than at ages 15 to 30 years during that period, whereas in the recent period, the percentage reduction under 15 years was less than at ages 15 to 30 years. Thus, the factors contributing to an improved mortality have become more effective in preventing deaths of young adults than previously, but white females have benefited much more than white males.

The result of the disproportionate decline in female and male mortality is shown by the ratios of male to female mortality for specific age groups in 1945 and in 1929–1931, which are plotted in the lower half of Figure 2. For every age group the excess male mortality has increased for both whites and nonwhites. For nonwhites, variation in the excess according to age is not large, but for whites the excess male mortality in 1945 was 30 per cent under 15 years of age, rose to 53 per cent at 15–30 years, declined slightly for the next 15 year age group, and increased again to 60 per cent at ages 45 to 60, after which it dropped to 30 per cent. This large excess mortality for adult males as compared with females represents one of our major health problems. Other data relating to it will be discussed later, but it may be said here that the causes are unknown.

Geographic Variation in Mortality

Geographic variations in mortality for the white population are shown in Figure 3 which ranks the age-adjusted mortality[2] of residents of each state in 1940 in one of five classes: (1)

[2] The age-adjusted death rates were computed for each state from age-specific rates given in Vital Statistics Rates in the United States, 1900–1940, Table 11, except that the infant mortality rate based on registered births and deaths under 1 year was substituted for the death rate under 1 year given in Table 11. Rates are adjusted to the age distribution of the population of the United States according to the 1940 Census. The age-adjusted rates used here differ very slightly from those in Age-Adjusted Death Rates in the United States, 1900–1940, Table 7 (3).

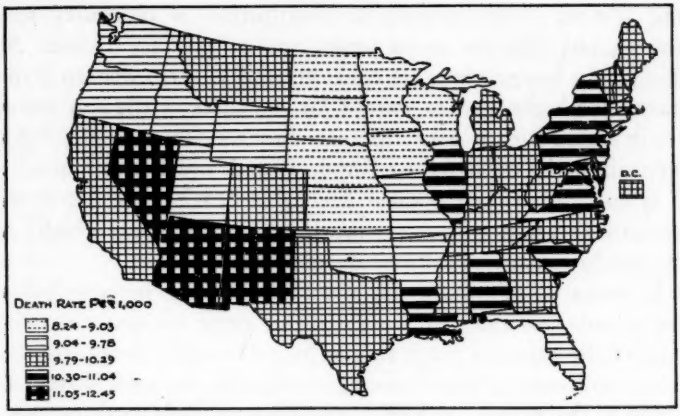

Fig. 3. Geographic variation in age-adjusted death rates in 1940 for white population. States are grouped by percentage deviation from the median rate for forty-nine states. *See* page 340.

more than 10 per cent below the median rate for the forty-eight state and the District of Columbia; (2) 2.6 to 10 per cent below; (3) not more than 2.5 per cent above or below the median rate; (4) 2.6 to 10.0 higher; and (5) more than 10 per cent higher. There is a marked regional distribution of low and high death rates though there are some exceptions. There are seven states in the group with minimum rates; all are in the West North Central division, except Wisconsin which is adjacent to them but conventionally classified in the East North Central division. All but two of the states with rates more than 2.5 per cent *below* the median are in the West, the exceptions being Connecticut and Florida. The highest mortality, more than 10 per cent above average, is found for only three states, New Mexico, Arizona, and Nevada. These are states affected by special conditions, two of them having long been a mecca for health seekers, especially those with tuberculosis and other respiratory ailments. The eleven states with moderately high death rates include the Middle Atlantic States, Rhode Island in New England, the northern part of the South Atlantic division, plus South Carolina, Louisiana in the South Central area,

and Illinois. This geographic distribution of mortality does not suggest climate as an important or primary factor. Although the lowest rates are concentrated in the northern plains states, the highest rates, except for the three in the southwest, are in states with widely differing climates, for example, Pennsylvania and Louisiana, or Rhode Island and South Carolina. It is apparent that the most favorable death rates are in the western agricultural states; the least favorable are chiefly in the highly urban and industrialized states.

In order to eliminate the effect of differing percentages of the population that were urban and rural on the mortality rates of the states, a death rate adjusted to equal proportions of urban and rural populations was computed for each state.[3] In Table 1, the states are listed according to their rank or order on the basis of the actual age-adjusted death rates and the rank of each state on the basis of the urban-rural adjusted rates also is shown. The West North Central states continue to show the most favorable rates. The major shifts are that the relative position of a number of East North Central and North Atlantic states is improved, notably the rank of Illinois, Ohio, New Jersey, New York, and Massachusetts; and the relative position of several Southern states and several Mountain states becomes less favorable, notably Arkansas, Wyoming, Idaho, Mississippi, Kentucky, and West Virginia. As a result of these changes, a larger number of Southern states have rates more than 2.5 per cent above the median rate than is shown by Figure 3, but New York, New Jersey, and Pennsylvania remain in this category. The broad pattern of geographic variation is not altered sufficiently by equalizing the urban-rural weighting in the total rates to indicate that urbanization *per se* is a major factor in the geographic variation.

For nonwhites the geographic distribution of mortality in

[3] The age-adjusted death rate for the urban population (cities of 2,500 population or more) of each state was weighted by the urban percentage for the United States in 1940 and the rural death rate in each state was weighted by the rural percentage for the United States. The urban and rural percentages for the United States in 1940 are 56.5 and 43.5 per cent, respectively. Age-adjusted urban and rural rates were taken from Table 7 of reference 3.

State	Age-Adjusted	Urban-Rural Adjusted	State	Age-Adjusted	Urban-Rural Adjusted
South Dakota	1	6	Maine	25	26
Nebraska	2	2	Ohio	26	17
North Dakota	3	8	Mississippi	27	37
Iowa	4	3	Massachusetts	28	20
Minnesota	5	1	Indiana	29	22
Kansas	6	4	West Virginia	30	39
Wisconsin	7	5	Delaware	31	23
Oklahoma	8	13	Kentucky	32	43
Arkansas	9	30	Georgia	33	38
Oregon	10	10	Texas	34	33
Florida	11	7	Vermont	35	35
Missouri	12	11	Illinois	36	21
Wyoming	13	24	Rhode Island	37	25
Connecticut	14	9	Alabama	38	40
Utah	15	12	Virginia	39	36
Idaho	16	34	New Jersey	40	32
Washington	17	14	New York	41	31
New Hampshire	18	15	Louisiana	42	44
Michigan	19	16	South Carolina	43	45
Montana	20	28	Maryland	44	42
North Carolina	21	27	Pennsylvania	45	41
California	22	19	New Mexico	46	46
Colorado	23	18	Arizona	47	48
Tennessee	24	29	Nevada	48	47

Table 1. Rank order from lowest to highest death rates for each state, 1940, according to age-adjusted rates for the white population and to urban-rural adjusted rates.

thirty-two states and the District of Columbia is shown in Figure 4 (rates are for Negroes only in Arizona, California, Oklahoma, and Nebraska). The states are grouped according to the percentage deviation from the median rate as in the case of whites, and it should be pointed out that the lowest rates for nonwhites is 12.5, the same as the highest rate for whites. For the nonwhite population, rates range from 12.5 to 19.4 and fewer states (six of the thirty-three states compared with nineteen of the forty-nine for whites) approximate the median. The lowest nonwhite rates are in the North and South West Central states, California and Massachusetts. Several states for which the white rates were relatively high had average or lower nonwhite rates as, for example, New York, Louisiana,

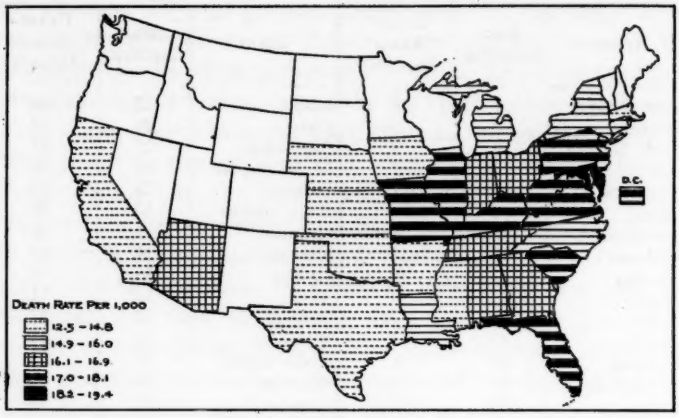

Fig. 4. Geographic variation in age-adjusted death rates in 1940 for non-white population of thirty-two states and the District of Columbia. States are grouped by percentage deviation from the median rate. *See* page 340.

and Alabama. There is somewhat the same tendency for high rates to occur in the industrial East and average rates to prevail in the North and South Central states.

Urban and Rural Mortality

It has long been known that, in general, urban populations have higher mortality rates than rural populations. Much of the public health program has been directed to the control and elimination of unfavorable conditions in cities, and in the early part of this century urban mortality rates declined sharply. But in the past twenty-five years it has not been possible to follow urban and rural trends in mortality because urban and rural rates were affected by the increasing use of urban hospitals by rural residents. In 1937, the National Office of Vital Statistics began the tabulation of deaths according to place of usual residence of the decedents and data are now available for somewhat detailed comparisons of mortality in cities and in rural areas. It is of interest to examine the nature of the urban-rural differences in recent mortality of the United States.

For the United States as a whole and for three broad regions, life tables on mortality during 1939 in cities with 100,000 population or more in 1930, in communities having a population of 2,500 to 100,000, and in rural areas have been published by the National Office of Vital Statistics (7). These life tables and death rates for specific states in 1940 will be used to describe recent urban-rural differences. The movement of the population since the 1940 Census has been so great that more recent urban and rural rates are not very reliable.

In Table 2, expectation of life at birth in the United States for the year 1939 is compared for rural areas and the two urban populations. White females had nearly the same expectation of life at birth in large and small cities; in the country they had an advantage of only a little over one year. For white males also there was little difference by size of city, but at birth rural males had 2.7 years more life expectation than males in small cities and 2.5 years more than those in large cities. These urban-rural differences are much less the differences shown by life tables for the Original Registration States (8) at the beginning of this century (Table 2). In the period 1900–1902, the expectation of life at birth for rural males exceeded that for urban males by 10 years, and for rural females the excess was 7.5 years.

A further point to be noted is that, although the expectation

Table 2. Average expectation of life at birth for urban and rural populations of the United States.

Year and Urban-Rural Class	White		Nonwhite	
	Male	Female	Male	Female
1939—Total United States:				
Cities 100,000 or More	61.6	66.3	51.0	54.6
Other Urban	61.4	66.2	46.9	51.1
Rural	64.1	67.5	55.2	57.2
Original Registration States:				
1909–1911				
Cities 10,000 or More	47.32	51.39		
Rural	55.06	57.35		
1900–1902				
Cities 8,000 or More	43.97	47.90		
Rural	54.03	55.41		

of life has increased greatly for both urban and rural populations, the urban increase has been greater for both males and females.

Trends in sex differences in expectation of life for urban and rural populations are of interest in view of the widening differential already noted. The expectation of life for females exceeds that for males both in urban and rural populations and at all three periods shown in Table 2. For the urban population, females had an average expectation of life four years longer than males had at both earlier periods and the difference increased only slightly (about three-fourths of a year) in 1939. For the rural population, the female expectation of life exceeded that of males by only 1.4 years in 1900–1902, but it has steadily increased and in 1939 the excess was 3.4 years.

Although the population of the Original Registration States is not strictly comparable with that of the total United States, it seems probable that two general conclusions are justified: first, that the urban-rural differential in mortality has been declining due to a more rapid improvement in urban mortality; and second, that the *increase* in the differential between male and female mortality is greater for rural populations than for urban although the absolute difference is greater for urban populations.

For nonwhites, the expectation of life at birth for rural males and females exceeded that in both large and small cities by a much greater amount than that found for whites. Underregistration of Negro rural deaths probably is a factor in this large excess but could account for only a part of it. Negroes had a definitely longer expectation of life in large cities than in small cities in contrast to the slight difference for whites.

A higher urban than rural mortality is characteristic of the white populations in nearly all states. Comparison of the age-adjusted urban and rural rates for states (3) in 1940 shows that the urban rate was higher in every state except in Massachusetts where the two rates were equal, and in California and New York where the urban rate was 0.1 per 1,000 less than the rural, and in New Jersey where the urban rate was 0.6

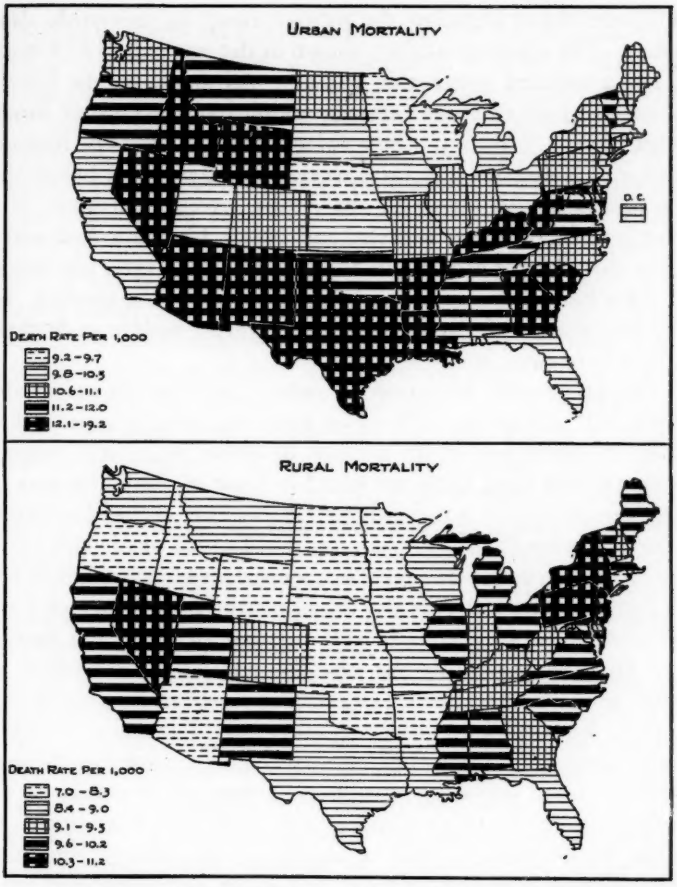

Fig. 5. Geographic variation in age-adjusted death rates in 1940 for the white population of urban and rural areas. Urban includes cities of 2,500 population or more.

lower. However, the states differ widely as to both urban and rural mortality and the pattern of variation is different.

The geographic variation of urban and of rural mortality for the white population of each state in 1940 is shown in Figure 5. States are grouped into five classes according to the percentage

deviation above or below the median rate,[4] as previously described. The urban mortality, shown in the upper half of Figure 5, has a marked geographic pattern. All states in the North which are east of the Mountain region had average or lower rates, except Vermont. Only three states, Wisconsin, Minnesota, and Nebraska, had rates more than 10 per cent below the median rate. All states in the South, except Delaware, the District of Columbia, Florida, and North Carolina, had rates more than 2.5 per cent above the median urban rate, and seven of them had rates more than 10 per cent above the median. In the Mountain and Pacific area, states varied widely as to their urban mortality.

The geographic variation of rural mortality shown in the lower half of Figure 5 follows an east and west division rather than the north and south division of urban mortality. Higher than average rural rates are found in most of the states east of the Mississippi River and only four states west of the Mississippi (New Mexico, Utah, Nevada, and California) are in this category. Thus, rural death rates are more consistently high in the industrial states than are the urban death rates. The latter are relatively low in a considerable number of industrial states.

In order to study the possible relation of mortality to some of the characteristics of populations of individual states, correlation coefficients for death rates and a few selected indices were computed. Some of these correlations are sufficiently suggestive of the influence of certain factors on mortality to be helpful in interpreting some of the mortality variations. It must be emphasized that a significant correlation does not demonstrate a causal relation and must be interpreted with great caution.

The rural populations in different states vary tremendously in the percentage that is classified as nonfarm. The range is from 27 per cent in Mississippi to 83 per cent in Connecticut, Rhode Island, and New Jersey. If the rural death rate for the

[4] Urban rates are for all places of 2,500 population or more, and the age-adjusted rates are taken from Table 7 of reference 3. Age-adjusted rural rates were computed for each state as described in footnote 2.

forty-eight states is correlated with the per cent of rural population that was nonfarm, a coefficient of $+.476$ ($P < .001$) is obtained and it is highly significant. In other words, the greater the proportion of rural population that was nonfarm, the higher the rural death rate. A similar correlation for the nonwhite population in the twenty-eight states in which nonwhites were over 90 per cent Negroes gave a coefficient of $+.623$ ($P < .001$). In the states west of the Mississippi, where low rural death rates were noted, the rural population is predominantly farm; in the east, especially northeast, the rural population is heavily weighted with nonfarm or small village populations and the mortality was relatively high. Since villages of less than 2,500 population apparently have a less favorable death rate than farm populations, even this degree of concentration of population seems to be unfavorable. However, an additional influence that may affect death rates of rural populations in the highly urban industrial states is the trend toward suburban living. Large numbers of persons live outside city limits and comprise a "fringe population" which finds employment in a nearby city or industrial area and in most respects is similar to the urban populations.

It is well known that the rural populations in various sections of the country differ greatly in their level of living or their socio-economic standards. For farm operators, an index of level of living based on money value of crops and several other items has been published by the Bureau of Agricultural Economics (9). On the assumption that the prosperity of farm communities closely parallels that of the farmers in the areas, this index of farm living was correlated with the white rural death rate for the thirty states in which the farm population was at least 45 per cent of the total rural population. The coefficient is $-.383$, only moderately high but statistically significant. When the correlation of the proportion of nonfarm families with the death rates in these thirty states is held constant, the coefficient for standard of living and the death rate is raised to $-.625$. Thus we have the suggestion of a second factor associated with

the death rates observed for rural populations, namely, the level of living for farm operators. So many conditions of living are associated with income that the specific factors of most importance in this relationship are not easily identified, but there are data to show that housing conditions, sanitary conveniences, medical care, and diets are less adequate in rural areas with low economic resources.

The white *urban* death rates (age adjusted) for forty-five states (Arizona, New Mexico, and Nevada excluded) were correlated with the average wage per male white worker who in 1940 received wages taxable for Federal Old Age and Survivors Insurance (10). The coefficient is $-.452$ ($P < .01$) and is statistically significant. This is high enough to suggest a moderate inverse relationship between wage levels and mortality. However, the wage level is highly correlated with the population per physician and per public health nurse in the state and is also associated with the quality of housing and of diet, and with indices of educational and cultural levels. Wages are the means by which the standard of living is modified, and carefully controlled investigations are required for an evaluation of the effect of separate socio-environmental factors on mortality.

Mortality by Age in Urban and Rural Areas

Age-specific mortality by urbanization in the three broad regions of the United States may be analyzed by using life-table mortality for 1939 from the report mentioned above (7). The regions for which urban and rural experience may be compared are: (1) the North which includes the New England states, Middle Atlantic states, East and West North Central states; (2) the South which includes the South Atlantic division, East and West South Central states; and (3) the West, or Mountain and Pacific Coast states. For each region and urban class, the percentages of the life-table population dying within each of five age intervals were computed for each sex and a mortality rate for both sexes obtained by averaging the male and female rates.

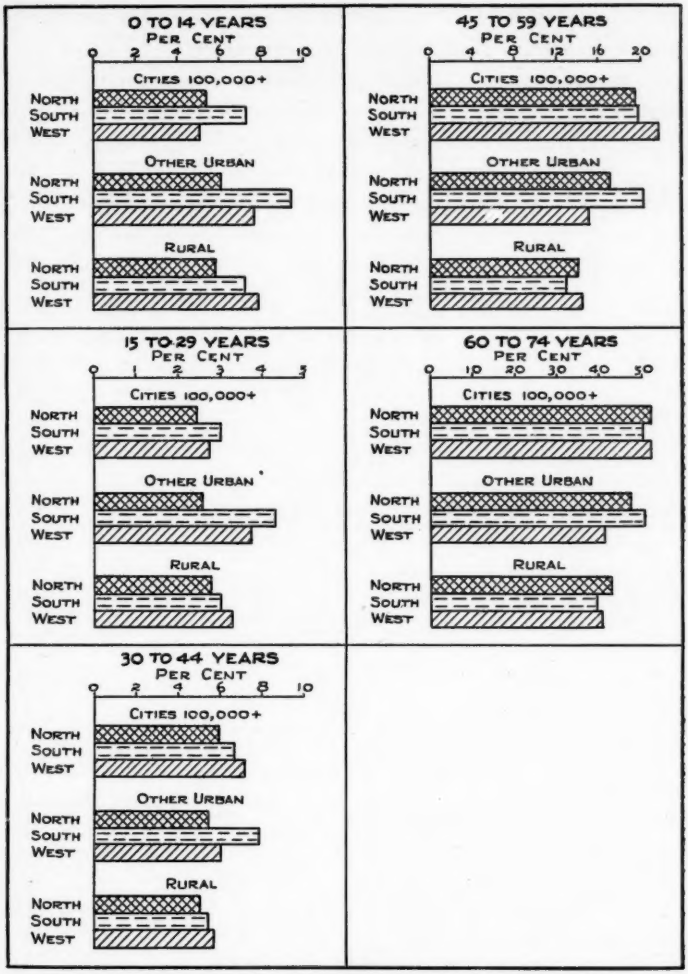

Fig. 6. Percentages of life-table population dying in specific fifteen-year age intervals compared for three regions of the United States for the white population of cities of 100,000 population or more, cities of 2,500 to 100,000 population, and of rural areas, 1939. Per cent dying is average of per cents for males and females.

Regional Comparison by Urban-Rural Class and Age. The

percentages of persons dying within a specified age interval in each of the two urban classes and in rural areas are compared for the three regions in Figure 6. The scale for percentages at each age period has been changed so that an equal distance between length of bars represents roughly equal percentage variation. The regional differences by urban class are not consistent for the various age periods and the three urban-rural classes do not show the same variation. The suggested pattern of variation may be summarized as follows:

1. Mortality is lowest in the North at each of the three fifteen-year age intervals from birth to age 45 years in rural areas, in small cities, and in cities of 100,000 population or more, with the exception that in large cities of the West mortality at ages 0 to 15 years is very slightly lower.
2. In the small cities, mortality is highest in the South at all five age periods and the largest regional differences are shown for this urban class. In large cities the highest mortality under age 30 is also in the South, but from 30 to 75 years mortality in the West is highest.
3. Rural mortality is highest in the West up to age 45 years, and thereafter the differences are small with minimum rates in the South.
4. The maximum regional variations are found for mortality in childhood and young adult ages.

Table 3. Age-specific death rates[1] per 1,000 population in 1940 in cities of 100,000 population or over and in rural areas of selected states[2] in four geographic areas.

Geographic Area	Cities 100,000 or More			Rural		
	Under 15 Years	15–44 Years	45–64 Years	Under 15 Years	15–44 Years	45–64 Years
North East	3.20	2.82	17.40	4.03	2.76	13.33
West North Central	2.80	2.17	12.70	2.94	1.95	9.01
South East	3.81	2.94	16.43	4.58	2.82	11.66
Pacific	3.17	2.87	15.44	3.69	2.94	12.61

[1] Rates for specific age groups were adjusted by age as follows: "Under 15 years" was adjusted for under 1 year, 1–4 years, and 5–14 years; "15–44 years" and "45–64 years" were adjusted for 10 year age groups. There was no adjustment for sex.

[2] For states included *see* page 353.

Since the North includes the West North Central states which have the lowest urban and rural mortality, the question arises whether the favorable mortality in the North is due to these states. In order to obtain some evidence on this point, Table 3 was prepared. For large cities and for rural communities, it compares the average death rates in 1940 of three age groups in selected states of four geographic areas. The areas and states included are: North East—Pennsylvania, Ohio, and Illinois; West North Central—Iowa, Minnesota, and Nebraska; South East—Alabama, Georgia, Tennessee, and Virginia; Pacific Coast—California, Oregon, and Washington. Rates for these West North Central states are much lower than those in any of the other areas for each age group both in the large cities and rural populations. Among the other three areas, differences in the death rates are less than those shown by the life-table mortality in 1939 for the three regions. However, in the large cities of the South East, mortality under 15 years of age was definitely higher than in the North East or the Pacific area, as was shown by the life-table mortality for the South. The only noteworthy shift in the relative position of geographic areas based on these selected states as compared with the larger regions is for the mortality under 15 years of age in the rural areas of the Pacific states which is lower than in either the North East or South East states, whereas the West region had the highest rate. Thus, although the lower mortality in the North is due to some extent to the low death rates in West North Central states, industrial states in the North East also have a favorable mortality among children and young adults.

Comparison of Urban-Rural Mortality Within Regions. Variation of mortality within regions according to degree of urbanization for specific sex and age groups is shown in Figure 7. Rural mortality for each age group has been taken as 1.00 and the ratio of mortality in each urban class to the rural rate has been plotted in Figure 7.

The age curve for ratios of mortality in large cities to that in rural areas is quite similar for all three regions. In the

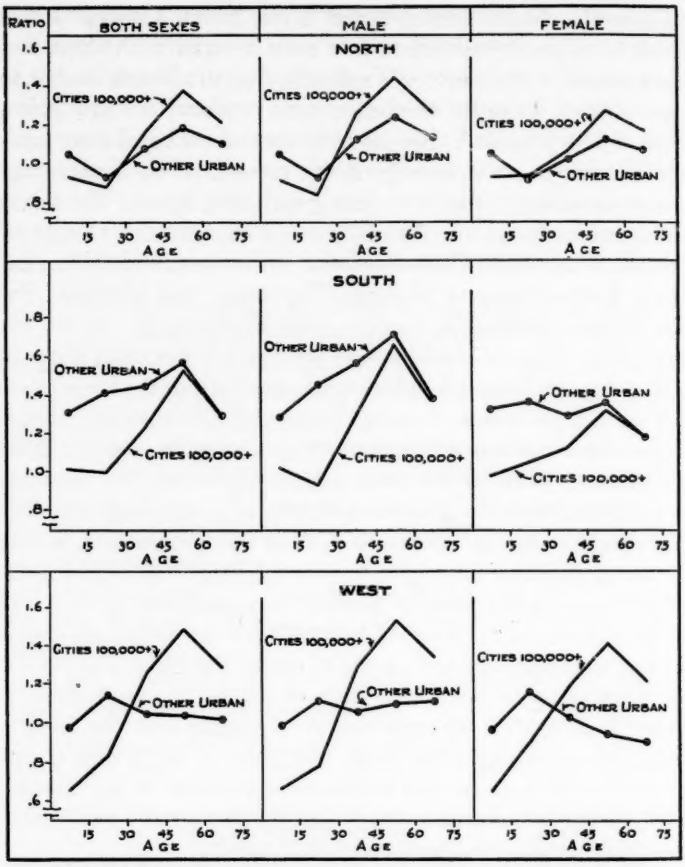

Fig. 7. Ratio of mortality in cities to rural mortality for the white population of three regions of the United States, 1939. Mortality is based on percentages of life-table population dying in fifteen-year age intervals, average of male and female per cents.

North and West, mortality at the two fifteen-year intervals under 30 years is lower than in rural areas, and in the South the rates are about equal. At all older age groups, the mortality is much higher in the large cities than in rural areas. The difference reaches a maximum at ages 45 to 60 years, and at this

age period the rate for large cities exceeds the rural rate by 38 per cent in the North, 49 per cent in the West, and 53 per cent in the South. The ratio curves by age for males and females separately are similar, but the mortality for males in large cities exceeds the rural mortality by greater percentages than does the mortality for females.

The mortality in small cities relative to rural mortality does not follow the age pattern shown by large cities and differs from region to region. In the North the mortality for the "other urban" class differs from rural mortality less than that of large cities at every age period. It is higher than the rural mortality at every age except 15 to 30 years, and the maximum difference occurs at ages 45 to 60 years with an excess of 19 per cent. In the West, mortality in small cities was slightly higher than in rural areas except under 15 years of age; the maximum difference of 14 per cent is for ages 15 to 30 years and at other age periods, including childhood, the difference varied from only 2 to 5 per cent. In the South, mortality in small cities was from 29 to 57 per cent above the rural mortality at the five age periods and was also much higher than in large cities for the three age groups from birth to 45 years.

In summary, this life-table mortality for 1939 indicates that urban conditions were associated with an unfavorable mortality for adults above 30 years of age and the unfavorable effects are more striking in the large cities except in the South where small cities had the higher mortality. On the other hand, it is interesting that large cities afforded the most favorable conditions for children and young adults, except in the South, and there the large city and rural mortality was equal.

These urban-rural differences in mortality for young people are evidence of the more effective control of diseases of childhood in cities than in the country. This is strikingly brought out if the corresponding comparison of proportions dying between birth and age 15 years is made for the years 1909–1911, using the life tables for urban and rural populations of the Original Registration States (8). In these years, 36 per cent

more persons died in cities between birth and 15 years of age than in rural areas. In 1939, only small cities in the South had any similar excess urban mortality in childhood.

For adults, conditions associated with urban life are nearly as unfavorable today compared with rural life as they were in 1910, although, of course, both urban and rural mortality have declined. For the United States, between age 45 to 60 years, life-table mortality in large cities in 1939 was 43 per cent higher than in rural areas compared with 54 per cent higher urban mortality in 1910. In the South, the urban excess was as high as in 1910. Since adult mortality has become our major health problem, the factors involved in high mortality for urban populations merit intensive study.

Sex Differences for Urban and Rural Mortality. It has been shown that the difference between male and female mortality has been increasing. It is of interest, therefore, to compare the sex ratios for life-table mortality in the three regions according to urbanization. The percentages by which male mortality exceeded female mortality are shown for the five fifteen-year age intervals in Figure 8. Variations in sex differences which seem relevant to this discussion may be briefly described as follows:

1. Under 15 years of age the percentage excess for male mortality varies little among regions or for urban-rural classes, the excess being from 21 to 29 per cent, although there were large differences in mortality by region and urbanization.
2. In both urban classes of all three regions the maximum excess mortality for males was at ages 45 to 60 years, which is the age group at which the greatest differences between urban and rural mortality is found within each region, except for small cities in the West.
3. At ages 60 to 75 years the excess mortality for males drops sharply, and it was less than in childhood except in the urban classes of the South and West.
4. Within each region the excess mortality for adult males in the rural area was less than in either urban class at each age interval except 15 to 30 years.

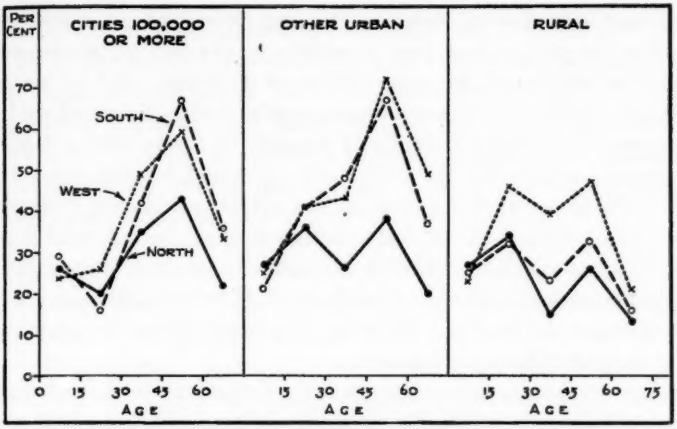

Fig. 8. Percentage excess in percentage of males in the life-table population dying in fifteen-year age intervals over percentage of females dying in the same age interval for urban and rural populations of the United States in three regions, 1939.

5. For each urban-rural class the excess mortality for males after age 29 years was least in the North.

In general, the specific regional, urban, and age classes which show a high sex-ratio for mortality are those which had relatively high death rates. In adult life, high mortality is associated with conditions which are more unfavorable to men than to women; or, stated in another way, the complex of factors which have brought about a marked decline in mortality has been more effective in postponing death for females than for males. In childhood and early adult life, the sexes have shared more equally in the decrease in mortality. It seems apparent that urban conditions are especially unfavorable to males and this suggests that factors associated with occupation or working conditions, and perhaps the strain of earning the living, may be involved.

Correlation coefficients were computed to test the association between the sex-ratio for mortality of the total white population of each state and several indices descriptive of the population for which data were available. There was no sig-

nificant correlation between the sex-ratio and an economic index for states based on a weighted average of wages per worker and rural farm operator level of living;[5] and no significant correlation between the sex-ratio and per cent of males engaged in manufacturing and mining. A fairly high positive correlation ($+.456$, $P < .01$) was obtained for the sex-ratio and the percentage *increase* in the urban population between 1920 and 1940. One can only speculate as to the interpretation of this association, but it is certainly suggestive that recent, rapid growth of cities has brought with it unfavorable mortality experience for males. Whether the new urban workers are those most affected is unknown.

Since urbanization is consistently associated with high sex-ratios for adult mortality, it seems safe to conclude that the steadily rising percentage of the total population that lives in cities is one factor in the increasing excess mortality of males as compared with females. On the other hand, there is evidence that the excess mortality for males has *increased* both in urban and rural areas. In Table 4, the percentage excess in life-table mortality in 1909–1911 for rural and urban males in the Original

Table 4. Ratio of the per cent of white males in the life-table population dying within a specified age interval to the per cent of white females dying in the same age interval for urban and rural population in 1909–1911[1] and in 1939.

Age Interval	1939—North Region		1909–1911[1]	1939 Rural North	1909–1911 Rural[1]
	Cities 100,000 or More	Cities 2,500–100,000	Cities 10,000 or More		
Years					
0–14	1.26	1.27	1.15	1.27	1.17
15–29	1.20	1.34	1.13	1.36	1.03
30–44	1.35	1.15	1.28	1.26	1.04
45–59	1.22	1.26	1.25	1.38	1.09
60–74	1.43	1.13	1.12	1.20	1.07

[1] Original Death Registration States.

[5] For each state the average wage per worker (10) and the index of farm level of living (9) was weighted by the per cent of total population in the state which was classified as nonfarm and farm, respectively.

Death Registration States is compared with similar data for 1939 in the North.[6] For each age interval the excess mortality for males was greater in 1939 than in 1909–1911 both for cities and rural communities. Therefore, the increase in the excess mortality for males in the total population cannot be explained entirely on the basis of the increase in the percentage of population that is urban.

Cause of Death

There is time for only a brief reference to specific causes of death but a comparison of death rates for a few causes in different geographic areas affords some significant information on the relative level of control of preventable diseases and on the importance of the degenerative diseases in the task of postponing death among the adult population. For the comparisons of death rates from specific causes, average rates were computed for a few states in four geographic areas, as described on page 353, for each sex in the urban and rural population. Rates were adjusted for differences in the age distribution of the population by the indirect method.[7] The mortality from specific causes is shown in Table 5 and in Figures 9 and 10.

Relatively high rates in the South East area for both urban and rural populations are shown in Table 5 for infant and maternal mortality, typhoid fever, malaria, communicable diseases of childhood, and pellagra. Mortality from these causes is preventable in large part, and this high mortality in the South East is indicative of inadequate health services

[6] This region is more comparable with the Original Registration States than the total United States, but sex-ratios in 1939 were even higher for the United States than for the North region.

[7] The indirect method used to adjust for age was as follows: (1) the total population by age for each specific subdivision (sex, urban or rural, geographic area) was obtained; (2) the population in each age group for a particular subdivision was multiplied by the age-specific death rate for the United States for the specific cause of death; (3) the products (expected number of deaths for a specific age group) were summed to obtain the number of deaths, all ages, that would be expected if the United States rate applied and this total was divided by the total population for the particular subdivision to obtain the expected death rate; (4) the ratio of the United States rate to the computed expected rate was obtained, and (5) the actual rate for the particular subdivision was multiplied by the ratio to obtain the age-adjusted rate.

and low standards of living. In the other three geographic areas, urban mortality from this list of causes was fairly similar, with the exception of pellagra mortality in the Pacific Coast states which was three and a half times that in the North East and West North Central area, although less than one-seventh of the urban death rate in the South East. Rural mortality was more variable than urban mortality from these causes. The North East states had less favorable rural death rates than either the West Central states or the Pacific Coast states for infant and maternal mortality, but for communicable diseases, mortality was similar in the North East and Pacific Coast states and higher than in the rural West North Central states. Only in the West North Central states was the rural death rate from these causes consistently as low or lower than the urban rates.

Table 5. Infant and maternal mortality and crude death rate per 100,000 population from selected causes for urban and rural populations of representative states[1] of four geographic areas, 1940.

Cause of Death and Urban-Rural Class	North East	South East	West North Central	Pacific Coast
Infant Deaths—Per 1,000 Live Births				
Urban	37.2	45.4	38.4	35.6
Rural	45.4	52.4	31.2	39.4
Puerperal Deaths—Per 1,000 Live Births				
Urban	3.0	3.5	3.3	2.8
Rural	3.0	4.1	2.4	2.3
Typhoid Fever				
Urban	.48	1.1	.51	.47
Rural	.82	1.5	.25	.80
Scarlet Fever, Whooping Cough, Diphtheria				
Urban	2.0	4.3	2.2	2.2
Rural	3.4	6.5	2.1	3.2
Malaria				
Urban	.09	1.2	0	.08
Rural	.09	2.3	.05	.03
Pellagra				
Urban	.14	3.8	.14	.52
Rural	.20	5.0	.14	.46

[1] States included are: North East—Illinois, Ohio, Pennsylvania; South East—Alabama, Georgia, Tennessee, Virginia; West North Central—Iowa, Minnesota, Nebraska; Pacific Coast—California, Oregon, Washington.

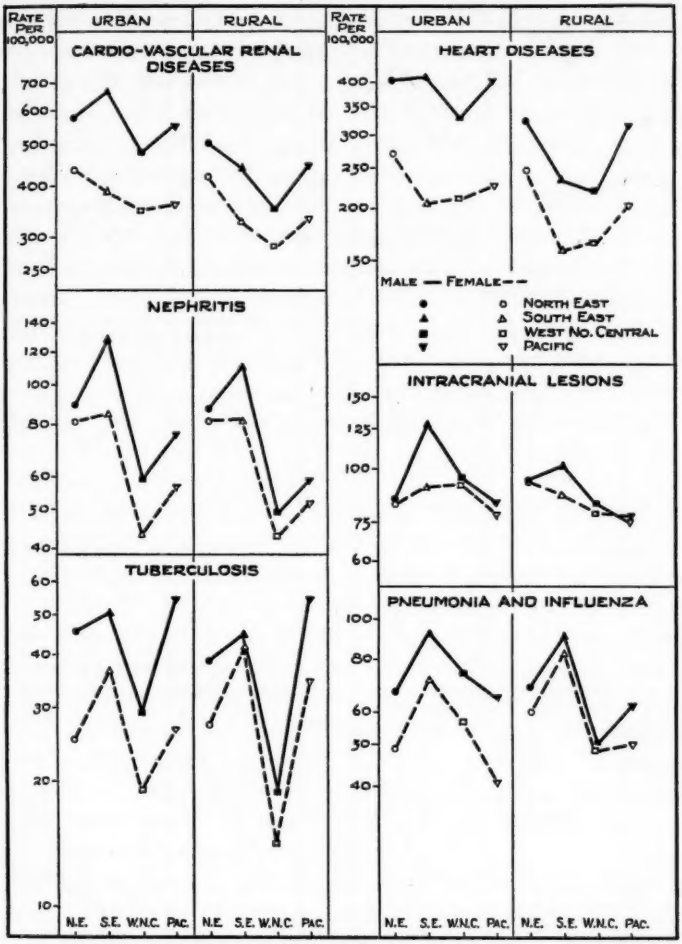

Fig. 9. Death rates in 1940 from several major causes of death for males and females in urban and rural areas of selected states in four geographic areas (*see* table 5, footnote). Death rates are adjusted for age by the indirect method. *See* footnote 7. Vertical scale is logarithmic.

Mortality from the major causes of death among adults is shown in Figures 9 and 10. In these charts the vertical scale

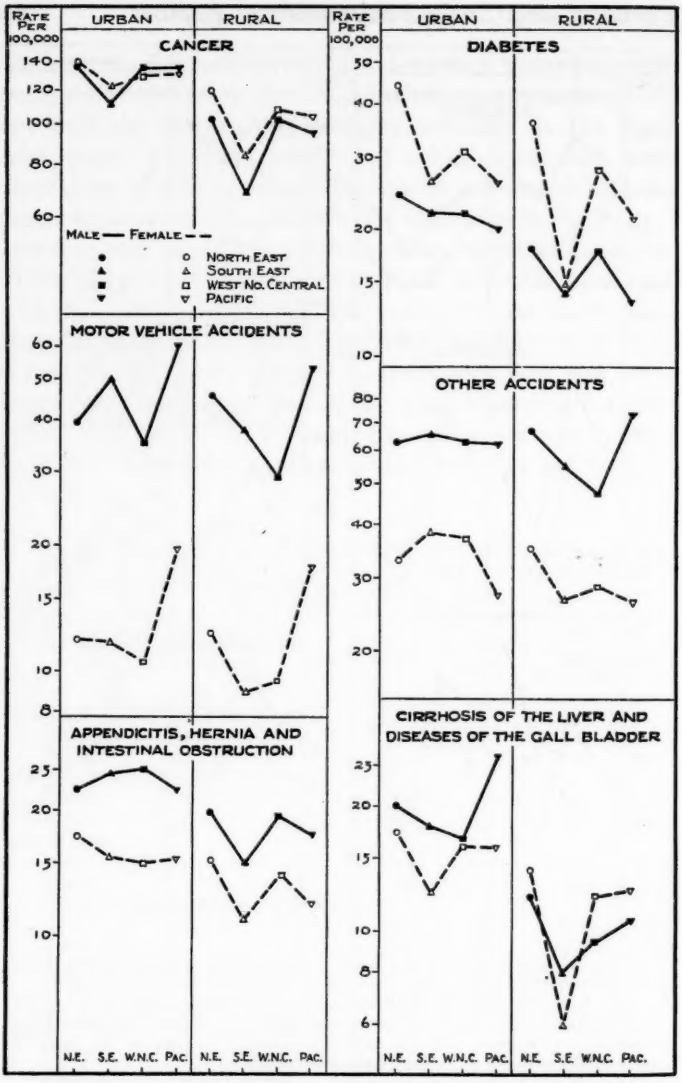

Fig. 10. Death rates in 1940 from several major causes of death for males and females in urban and rural areas of selected states in four geographic areas (see table 5, footnote). Death rates are adjusted for age by the indirect method. *See* footnote 7. Vertical scale is logarithmic.

(rate scale) is logarithmic and equal vertical distances between points represent equal percentage differences.

For nearly every cause, or group of causes, the death rate for males is higher than that for females, both for urban and rural populations of each geographic area. The differences in the rates by sex are usually greater in urban than in rural areas. Diseases which show the most marked excess mortality for males are the cardiovascular renal diseases, especially heart diseases, tuberculosis, pneumonia and influenza, diseases of the intestines, including appendicitis, hernia, and obstruction. Accidental deaths, especially those due to motor vehicles, show a greater percentage difference in mortality by sex than any of the diseases, both in urban and rural areas, and the actual differences in rates for the two sexes for accidental deaths from motor vehicles and other accidents are exceeded only by the cardiovascular renal diseases.

Higher mortality among females is found for diabetes in urban and rural populations of each of the four geographic areas. Cancer mortality also is somewhat greater for females than males in the rural population of each area, and in the urban population of the North East and South East states but not of the West North Central and Pacific states. The mortality from cirrhosis of the liver and diseases of the gall bladder combined is higher among females in rural sections of each area, except the South East, but is higher for males in urban sections. However, cirrhosis of the liver, separately, causes more deaths among males and gall bladder diseases cause more deaths among females.

Marked geographic differences are shown for most of these causes. Variations of special interest are: (1) the high male urban death rate from cardiovascular diseases in the South East states where total urban mortality has been shown to be relatively high; (2) a maximum death rate from influenza and pneumonia among both males and females in urban and rural areas of the South East; (3) the high tuberculosis rate for males and females in the South East states and in the

Pacific states, especially among males; and (4) the high accident rate for the Pacific Coast states.

Little is known concerning the effect of social or environmental factors on these causes, except tuberculosis and pneumonia. These two diseases are infectious and a relation to low standards of living, crowding, density of population, and some other conditions has been shown by special studies. The causes of accidents are being intensively studied as a basis for their prevention. Until quite recently the relation of environmental factors to the degenerative diseases has not received much attention. Their epidemiology, in the broadest sense, needs to be studied but the usual published mortality data can afford little more than some clues to be followed up by special investigations.

Conclusion

This discussion has considered only the broad pattern of recent mortality variations in this country. Mortality within limited sections of large cities, *i.e.*, for census tracts or groupings of such tracts, also has been most helpful in showing the association of poor living conditions with high death rates, and data of this type will be discussed by another speaker. Variations in mortality for different occupational groups also will be presented in another paper.

Some general conclusions that may be drawn from the data presented in the foregoing discussion are as follows:

1. Reductions in mortality have been greatest for children and young adults in large urban centers, where medical and public health services have had the greatest development and are most available.

2. Preventable mortality among children is relatively high in rural communities of most sections of the United States and is high in the smaller cities of the South.

3. In middle life, urban males have a marked excess mortality as compared with females, and the difference has been increasing. Although the excess mortality for rural males is less, it has been increasing also.

4. Geographic and urban-rural variations in adult mortality and in the differences in the sex-ratio for adult mortality suggest the importance of socio-environmental factors.

5. The causes of premature breakdown in middle life, especially for males, needs to be studied more intensively.

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SOCIAL AND ENVIRONMENTAL FACTORS IN ILLNESS[1]

JEAN DOWNES

IT seems proper to open this discussion of social and environmental factors in illness by citing a statement made by Sydenstricker (1) in 1933 in his book HEALTH AND ENVIRONMENT:

> The entire or total environment of an individual or of a population is a complex of so many and so varied conditions that it is impossible to express it in simple terms or by means of a single index. The student of the relation of environment to health, by whatever index health itself is designated, is apt to confine himself rather closely to some one phase of environment, such as the economic, the occupational, or the geographic, instead of environment in its entirety. We have as a result a highly specialized series of inquiries on health and environment. . . . . The danger in these highly specialized studies is that other aspects of environment, which may have a direct bearing on the particular phase under consideration, are not taken into proper account.

The purpose of this paper is to present some of the most recent data drawn from various sources which illustrate the breadth or the limits of our knowledge of the relationship of illness to various social and environmental conditions.

Data of total morbidity have been obtained only through special investigation of samples of population groups. Those which will be referred to particularly are: the National Health Survey in 1935–1936 of slightly more than 2,000,000 persons in 917,000 households in urban communities in various parts of the United States[2] (Negro families were included in this survey); a study of farm families in Michigan; and the morbidity study which was conducted over a period of five years in

[1] From the Milbank Memorial Fund.

[2] The urban surveyed population was so distributed as to give a sample which was, in general, representative of cities in the United States, according to size and region.

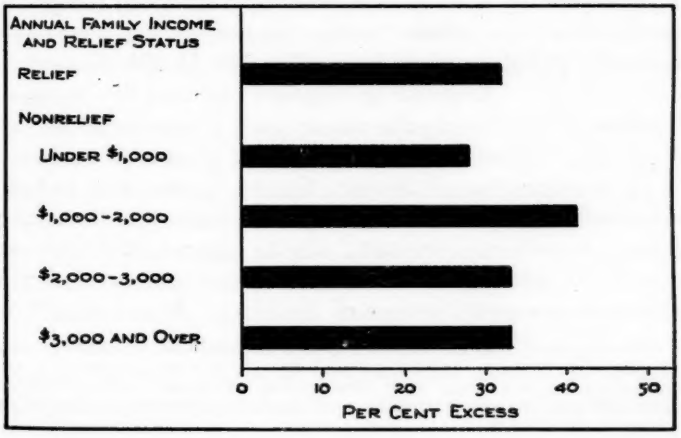
some 2,000 white families living in the Eastern Health District of Baltimore.

In all of these studies of morbidity, information was obtained concerning certain aspects of the environment of the family, such as age and sex of the population under consideration, size of community, income, amount of rent or value of owned homes, certain data on housing conditions, and occupation of employed members of the family. In addition to these, educational level of the family members was included in the Eastern Health District Study. Also, for the National Health Survey population, information was obtained as to whether the head of the household had moved to the city from a farm during the ten years preceding the survey. Thus it is possible to consider morbidity in relation to some of these factors.

Rural-Urban Migration

In the past there has been speculation as to causes of the differential mortality between urban and rural areas. One suggestion has been made that the migrants from rural to urban areas are composed of the more physically fit. The National

Fig. 1. Excess of disabling illness among migrants over that of the total urban sample. (Data from Freedman, Ronald: Health Differentials for Rural-Urban Migration. *American Sociological Review*, October, 1947, 12, No. 5.)



Health Survey included information as to whether the head of the household had moved from a farm during the ten years prior to 1935–1936.

Freedman has studied the disabling illness among 85,264 urban persons who were classed as rural-urban migrants and compared their rates with those of the entire urban sample (2). The excess of disabling illness among migrants over that of the total sample classified according to annual income of the family is shown in Figure 1. There was a substantial excess in every income class. These excesses were not due to the effects of an excess of Negro migrants or to differential age distribution. Freedman conluded that "the data in this study are not consistent with the hypothesis that rural-urban migrants are healthier than the general urban population."

Illness by Age

Statistics of illness at adult ages portray conditions and disease as manifestations of impaired vitality. The frequency of all illness is highest in childhood, due chiefly to respiratory diseases and the acute communicable diseases, lowest in the ages 15–24, and increases gradually after age 25.

That the increase of illness with age is a manifestation of impaired vitality may be illustrated by a study of the prevalence of the more serious chronic diseases among some 1,200 husbands and their wives in the Eastern Health District of Baltimore (3). As shown in Figure 2, at ages 20–34, about 4 per cent had chronic disease; in each of the next two age groups the rate more than doubled; and at ages 65 and over, 43 per cent had chronic disease. Chronic disease here includes conditions which are leading causes of death: cardiovascular disease, hypertensive vascular disease, cancer, and diabetes, as well as conditions such as the psychoneuroses and arthritis, which cause a great amount of disability.[3] It is a significant

[3] The diseases or affections which are included are as follows: tuberculosis, malignant neoplasms, diabetes, psychoses, psychoneuroses, heart disease, hypertensive vascular disease, varicose veins, peptic ulcer, gall-bladder disease, chronic nephritis, arthritis, hernia, and asthma. *Only cases diagnosed by a private physician, clinic, or hospital are included.*

fact that at ages 45–64, which should be a most productive period of life, slightly more than one-fourth of these husbands and wives had chronic illness. The fact that the prevalence of the chronic diseases increases rapidly as age increases and that such conditions occur most frequently within well-defined age limits might be taken to constitute presumptive evidence that some environmental condition, either external or internal, peculiar to middle and old age is necessary for their development. The usual explanation is that the "aging process" is common to those specific ages and that chronic disease is associated with the "aging process." This explanation is not entirely satisfactory and is cited only to emphasize the complexity of the problem of studying environment and disease.

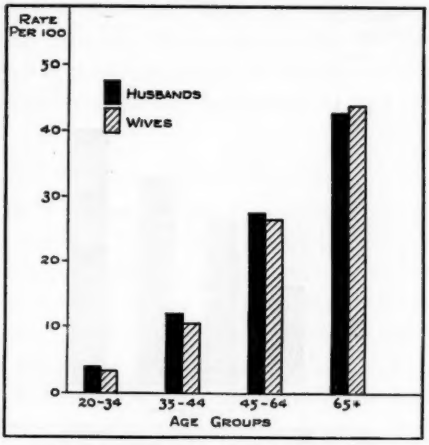


Fig. 2. Prevalence of chronic disease among 1,289 husbands and their wives. (Data from Downes, Jean: Chronic Diseases Among Spouses. The Milbank Memorial Fund *Quarterly*, October, 1947, xxv, No. 4.)

Chronic disease is not a result of age *per se* inasmuch as it occurs at relatively young ages in some people and not all persons at advanced ages develop the same chronic condition. Thus it would seeem that a particular setting or background is involved. The study of the 1,200 spouses offers some suggestive evidence on this point.

The association of chronic disease without respect to cause was studied for husbands and their wives in four different age groups. In each age group the observed number of instances where both the husband and his wife had a chronic disease was

considerably greater than the number expected to occur concurrently if such conditions occurred at random among husbands and wives. These differences were statistically significant. Chronic disease by specific cause was considered only for the married pairs 45 years of age and over. A signficant association of illness in both husband and wife was found for all circulatory diseases combined, for hypertensive vascular disease and for arthritis. These spouses had shared the same environment over a period of years and the results suggest that the immediate domestic environment may be a factor of some importance in the occurrence of certain chronic diseases.

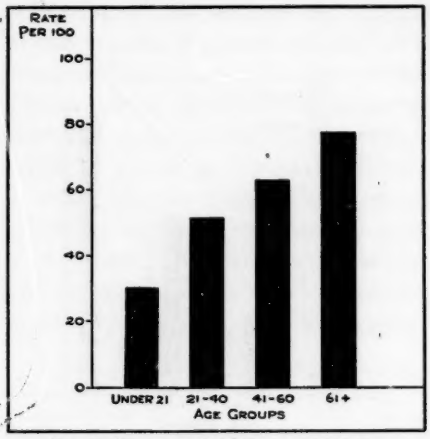


Fig. 3. Per cent of 1,219 persons in farm families reporting positive symptoms of illness. (Data from Hoffer, Charles R.: Medical Needs of the Rural Population in Michigan. *Rural Sociology*, June, 1947, 12, No. 2.)

A study of significant symptoms and complaints among 1,219 persons in a carefully selected sample composed of 308 farm families in rural Michigan showed that the proportion having such symptoms increased markedly with age (4). (Figure 3.) These data are not comparable with the usual statistics of morbidity since they include some impairments and complaints without overt illness.[4] Approximately every sixth

[4] The most frequent symptoms or complaints reported were:

	Per Cent
Toothache	10.0
Persistent Pain in Joints	10.0
Poor Vision	8.0
Persistent Headaches	7.5
Persistent Backache or	6.1
Repeated Hernia	4.1
Severe Shortness of Breath	3.4
Fatigue (Unexplained)	3.3

(Continued on page 371)

family was asked to have a clinic examination made by a physician from the Medical School of the University of Michigan. In eight out of ten cases there was agreement in the physicians' findings and the reported illness or complaint. These data are significant with respect to the proportion affected at different ages and it is evident that the prevalence of persons with symptoms and complaints increases as age increases.

Illness Among Negroes and White Persons

It is recognized that in any community in which Negroes form a part of the population the Negroes generally live under less favorable environmental conditions than does the white population. The majority of them belong to the lowest income group. The National Health Survey has made available general morbidity data for a sample of Negroes and white families living in the same communities (5). The data are presented for a total of four cities: Atlanta, Cincinnati, Dallas, and Newark, New Jersey.

For all ages combined (Figure 4) there was an excess of 31 per cent in the prevalence of disabling illness among Negroes compared with that among white persons. Six out of one hundred Negroes and slightly more than four out of one hundred white persons were disabled by illness on the day the family was visited. The chart indicates that this excess was due to higher rates among adult Negroes. At these ages the prevalence of disabling illness was from 62 to 77 per cent higher than among white persons.

The incidence of disabling illness—disabled seven days or longer during a twelve-month period—showed differences between Negroes and white persons somewhat similar to those noted for prevalence. After age 15 the rates among Negroes were from 24 to 43 per cent higher than those for white persons at the same ages.

Persistent Swelling of Ankles	2.4
Asthma	2.3
Repeated Nose Bleeds (Not Due to Injury)	2.2
Continued Loss of Appetite	2.5
Unexplained Loss of Weight	1.9

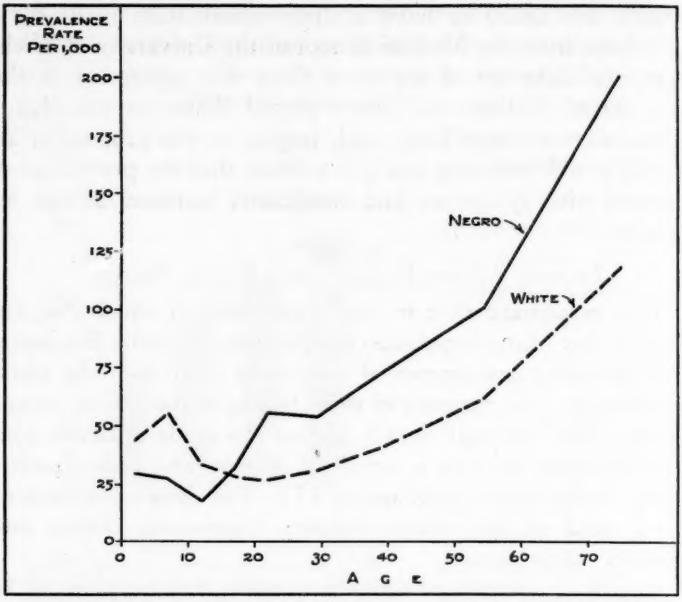


Fig. 4. Prevalence of illness among white persons and Negroes in four cities. (Data from Holland, Dorothy F. and Perrott, G. St.J.: Health of the Negro. The Milbank Memorial Fund *Quarterly*, January, 1938, xvi, No. 1.)

When certain important causes of disabling illness are considered (disabled seven days or longer during a twelve-month period), it is apparent (Figure 5) that the excess among Negroes was present for every cause except for illness due to the puerperal state (6). These differences in illness rates can hardly be attributed to true racial differences; in all probability they reflect wide differences in income and other aspects of social environment. Figure 5 is based upon data of the National Health Survey for New York City.

If the differences between Negroes and white persons with respect to morbidity are due to differences in the social and economic environment of the two groups, it is noteworthy that the results of environmental influences are most evident after adult life has been reached.

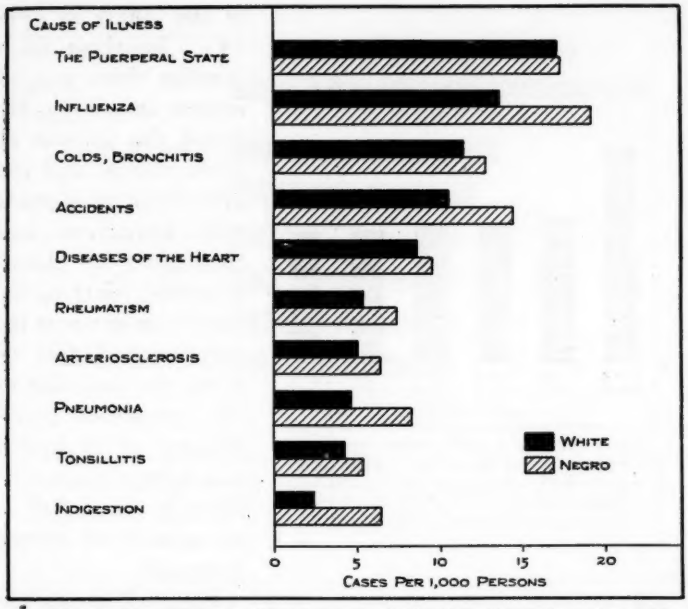


Fig. 5. Case rates of selected causes of disabling illness in whites and Negroes in New York City. (Data from Holland, Dorothy F. and Altenderfer, Marian E.: Sickness in a Metropolitan Community: Some Results of a Health Survey of New York City. United States Public Health Service, 1946.)

Illness by Income Groups

The earliest studies of morbidity indicated a negative correlation of illness with economic status; the lowest income group had the highest morbidity rate and the higher income groups had lower rates of illness. More recent studies have confirmed and added to these findings. It is of interest to consider data only recently available, morbidity by income for farm families; also, chronic illness and certain specific diagnoses by income class.

Figure 6 shows the proportion of persons in specific income groups who reported significant symptoms and complaints. These data are based upon the 1,219 persons from the 308 farm families in rural Michigan. "Income" is the gross farm income

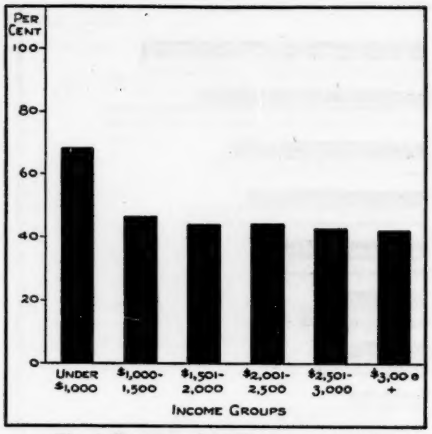


Fig. 6. Per cent of 1,219 persons reporting symptoms classified according to gross farm income in 1945. (Data from Hoffer, Charles R.: Medical Needs of the Rural Population in Michigan. *Rural Sociology*, 12, No. 2.

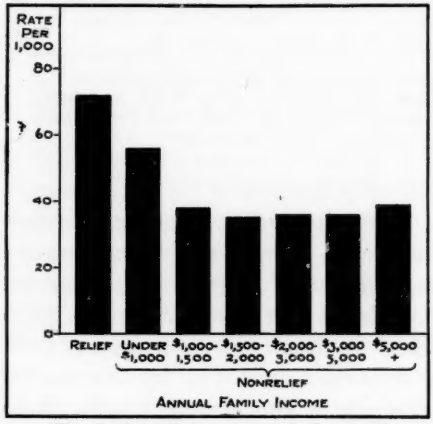


Fig. 7. Annual frequency of chronic illness—disabling one week or longer. (Data from Britten Rollo H.; Collins. Selwyn D.; and Fitzgerald, James S.: The National Health Survey: Some General Findings as to Disease, Accidents and Impairments in Urban Areas. *Public Health Reports*, March 15, 1940, 55, No. 11.)

of the family in 1945 (4). In these farm families there was an inverse association between the amount of gross income and the prevalence of persons with symptoms and complaints of illness. However, for those income classes where income was $1,000 or more, the variation in the proportion complaining of ill health was slight, though consistently downward as the amount of income increased.

Figure 7 shows the occurrence of disabling illness (three months or longer) from chronic disease among the National Health Survey urban population classified according to income (7). Here again the highest rate of illness was found to be among persons in the lowest income classes. In the classes where income was $1,000 and above there was little varia-

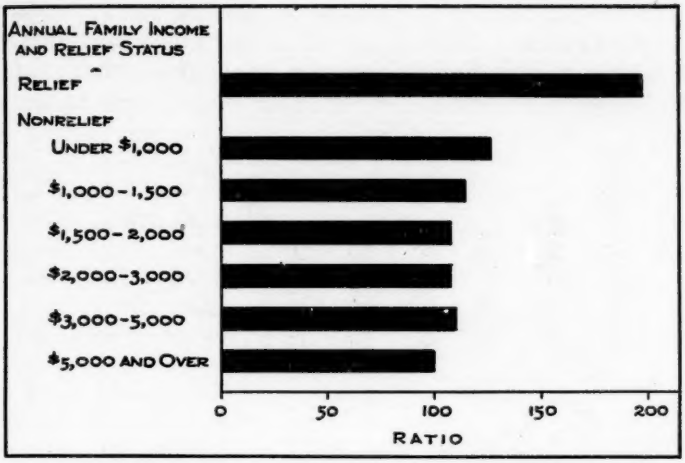


Fig. 8. Ratio of the case rate of pneumonia of each income group to that of the highest income group. (Data from Britten, Rollo H.: The Incidence of Pneumonia as Recorded in the National Health Survey. *Public Health Reports,* October 2, 1942, 57, No. 40.)

tion in the rate of chronic illness. Except for the lowest income groups there seems to be little association between all chronic illness and family income. This is not surprising since chronic disease is common to so many of the older adults.

Certain specific illnesses, however, do show a more marked association with family income. Illness from pneumonia (Figure 8) illustrates this fact (8). The lower the income the higher was the frequency of this disease.

Rheumatic fever which is considered a chronic disease also shows a marked association with income (9). Figure 9 illustrates this fact. These data are from a special investigation made by Collins and which was a part of the National Health Survey. The population included some 800,000 white persons 5–19 years of age drawn from eighty-four cities. Collins' interpretation of Figure 9 is as follows:

> It is seen that the prevalence rate (disabled at any time during the year) among families on relief stands out as exceptionally high but the incidence rate (new cases) for this group is not so

exceptionally high. . . . However, the relative increase in the rates as income decreases, aside from the high relief rate, is slightly greater in new cases than in total prevalence. This latter suggests that the environment which accompanies low income may be an active factor in producing the disease, but the former suggests that these serious diseases may also be the reason for securing relief or the cause of poor economic status; relief in some cases follows rather than precedes the onset of the illness.

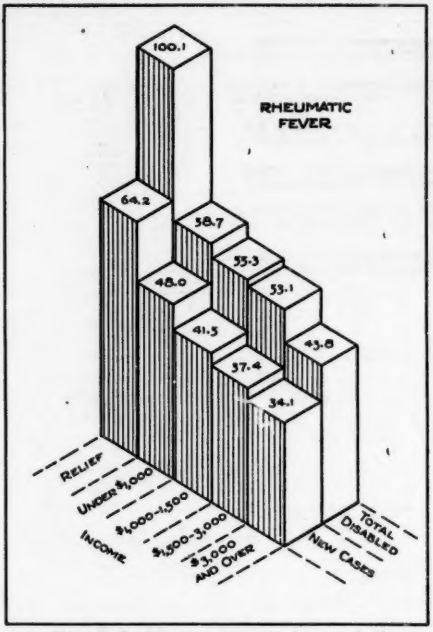


Fig. 9. Incidence and prevalence of disabling rheumatic fever according to income of the family. (Data from Collins, Selwyn D.: The Incidence of Rheumatic Fever as Recorded in General Morbidity Surveys of Families. Special Supplement to *Public Health Reports*, 1947.)

Both the morbidity from pneumonia and rheumatic fever show a closer association with economic environment than does total disabling chronic disease or all illness as expressed in symptoms and complaints.

Illness and Crowding

One environmental factor, crowding; that is, the number of persons who occupy a dwelling unit in relation to the number of rooms in the unit, has been studied in relation to illness by Britten (10). The data presented are based upon a population of about 1,700,000 white persons from the National Health Survey. As shown in Figure 10, there are three "crowding"

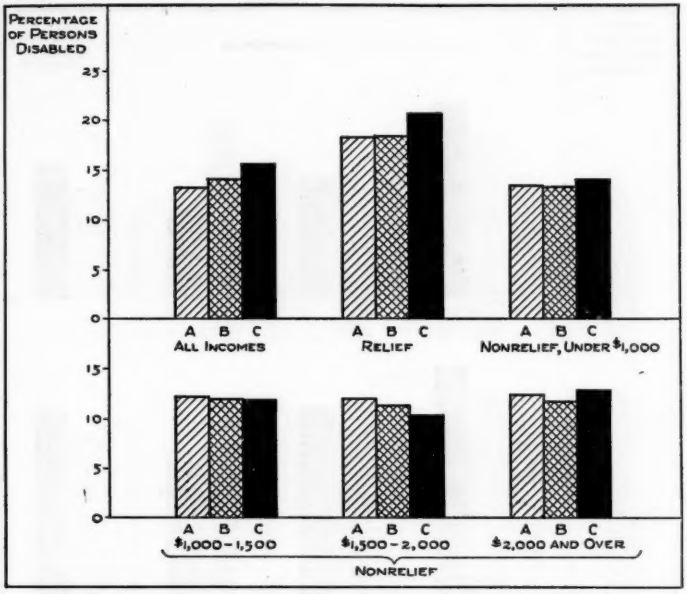


Fig. 10. Percentage of persons disabled for a week or longer during one year, by degree of crowding and economic status. (Data from Britten, Rollo H. and Altman, Isidore: Illness and Accidents Among Persons Living Under Different Housing Conditions. *Public Health Reports,* March 28, 1941, 56, No. 13.)

classifications: "A", one person or less per room; "B", more than one person but not more than 1.5 persons per room; and "C", more than 1.5 persons per room.[5] Crowding is a crude measure of economic status; the inverse correlation between income and crowding is high. The effect of income is partially eliminated by making comparison of disabling illness rates within fairly specific income groups. In general, the relative increase in the percentage of persons with disabling illness varied inversely with income. That the ratios of the rates in Category "C" to those in Category "A" were lower for specific income groups than for the population as a whole, according to Britten, is explained by the interaction of two factors: (1) the higher

[5] The data of illness are adjusted to the age and household-size distribution of the total white population studied.

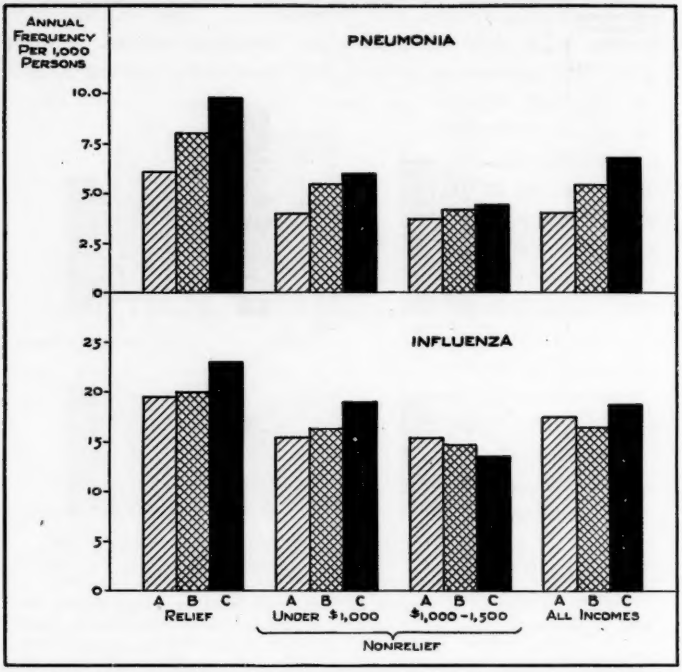


Fig. 11. Annual frequency among persons of two diagnoses by degree of crowding and economic status. (Data from Britten, Rollo H. and Altman, Isidore: Illness and Accidents Among Persons Living Under Different Housing Conditions. *Public Health Reports,* March 28, 1941, 56, No. 13.)

illness rates in the low-income classes, and (2) the greater concentration of these low-income groups in the categories of increased crowding.

Figure 11 summarizes the frequency with which pneumonia and influenza disable persons in different economic groups and living under different degrees of crowding. The marked increase in the frequency of pneumonia as crowding increased is noteworthy. Figure 12 shows data for tuberculosis and rheumatism. Here the increase of illness with increase in crowding is more marked for tuberculosis than for rheumatism.

Britten concludes that the data presented in his report, of

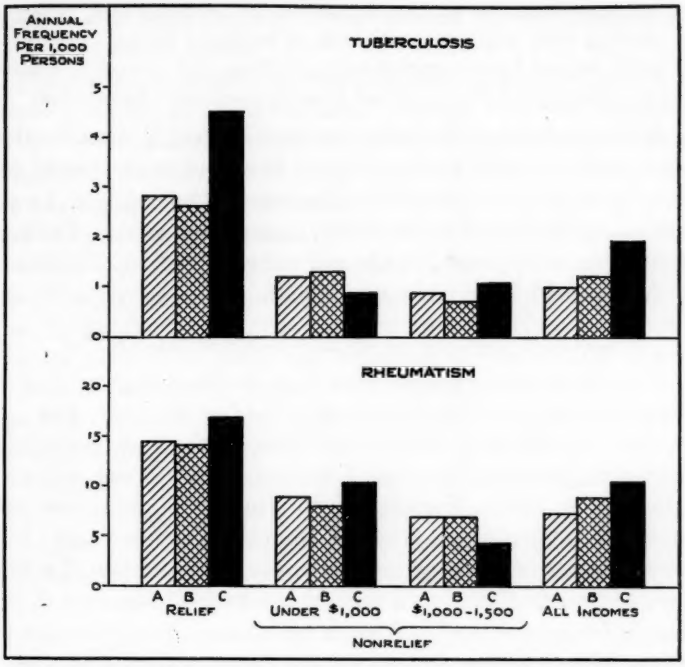


Fig. 12. Annual frequency among persons of two diagnoses by degree of crowding and economic status. (Data from Britten, Rollo H. and Altman, Isidore: Illness and Accidents Among Persons Living Under Different Housing Conditions. *Public Health Reports,* March 28, 1941, 56, No. 13.)

which only a small part has been shown here, has established an important broad association between housing and health. He discusses the difficulties in interpretation of the results as follows:

> Complicating factors, such as differences of income, of race, of educational and intelligence level, constitute a serious limitation upon the interpretation of the data. The most serious limitation perhaps lies in the element economic status. Sometimes disease or impairments cuts down income, or prevents entirely the earning of a livelihood and so forces families into poor housing, the only kind they can afford. Sometimes low income causes or per-

petuates disease by making impossible an adequate diet, proper medical care, and other essentials of healthful living. Persons badly housed have excessive rates of illness and mortality quite apart from the influence of the housing conditions themselves.

Britten explains that the degree-of-crowding classification was employed with no intention of fixing an exact line of demarcation between crowded and uncrowded households. To establish such a line of demarcation, factors such as size of rooms, size of household, and the age and sex composition of its membership would have to be considered.

Chronic Disease as an Environmental Factor

A study of illness among school-age children may be used to illustrate the possible influence of social factors other than age, income, or crowding which may affect the rate of morbidity. The data presented are based upon a sample which includes 214 families in the Eastern Health District of Baltimore observed for illness over a period of from three to five years (11). In each of these families there was one or more children of school age, and a school-age child formed the basis of selection of the family for special study. Also, in each family there was one or more cases of chronic disease, usually among the adult members of the family.

It was possible to classify the school-age child who brought the family into the study (the index case) according to his sickness record during a particular twelve-month period. Sixty-three of the 214 children had three or more illnesses; the remaining 151 children either suffered no illness or had less than three illnesses during the year under consideration.[6]

Examination of the illness rates of the school-age siblings of each of these two groups of children revealed a striking difference between them. Siblings in the families selected on the basis of a child who had three or more illnesses had an annual illness rate three times as great as the rate among siblings of the index

[6] Attacks of acute communicable diseases, infectious skin conditions (ring worm, impetigo, and scabies) and tonsillectomies are excluded; also chronic disease is excluded.

cases in the other families. This was true for disabling illness as well as for all illness.

Further study indicated that there was a tendency for children to remain at about the same sickness level over a period of five years; that is, sickly children remained sickly. There were sickly families and healthy families as judged by morbidity among the children in them.

This question is pertinent: Were there wide differences between these two groups of families with respect to certain social and environmental conditions which may be related to the differences in the rate of illness of the child population? It was possible to study the following environmental conditions: size of family, degree of crowding, income, educational level of the head of the household, and the type of chronic disease in the family.

There were no important differences between the "sickly" and "nonsickly" families with respect to size or degree of crowding. The median size of family was similar in both groups —5.3 and 5.6, respectively. A relatively high proportion of the families in both groups were graded as crowded; that is, having an unsatisfactory number of rooms in relation to the number, age, and sex constitution of the family members. Thirty-six per cent of the "sickly" families were crowded and 35 per cent of the "nonsickly" were so classified.

There were no important differences between the two groups of families with respect to annual income. Only about one-fourth of the families in each group had an income of $2,000 or more per year.

In about 60 per cent of the families in each group the head of the household had less than an eighth-grade education, very few had any high school education, and there were none who had any college or other advanced schooling.

The head of the household had chronic disease in 44 per cent of the "sickly" families compared with 49 per cent in the "nonsickly" group. Most of this chronic disease was nondisabling. The proportions where the head of the household was disabled

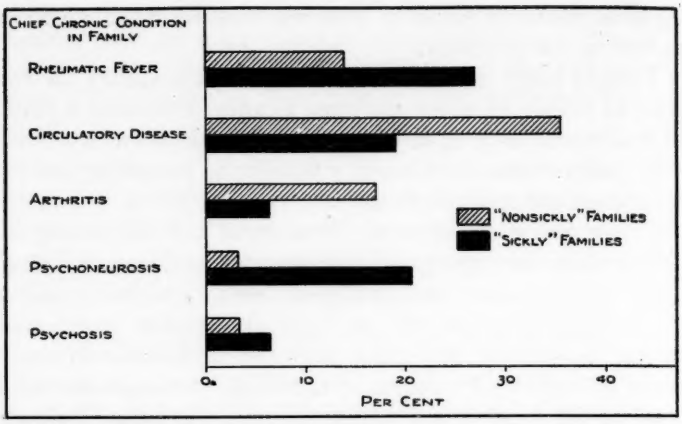


Fig. 13. Per cent of families, "sickly" and "nonsickly" with specified chronic condition.

were as follows: "sickly" group 5 per cent; "nonsickly" group 3 per cent.

However, there was a greater concentration of adults with chronic illness in the "sickly" families. The housewife had chronic disease in 80 per cent of the "sickly" compared with 45 per cent of the "nonsickly" group. Both husband and wife were affected in 32 per cent of the former compared with 16 per cent of the latter group.

When type of chronic disease in the family is considered there are striking differences between the two groups. Figure 13 shows the proportion of families in each group in which certain selected chronic conditions were present. In the "sickly" families there was a higher proportion with rheumatic fever, psychoneuroses, and psychoses than was noted for the "nonsickly" group. Fifty-three per cent of the "sickly" families had such cases of illness compared with 20 per cent of the families classed as "nonsickly."

It is not surprising that classification of a family by frequent illness of a child member has selected a relatively large number of "rheumatic fever" families into the "sickly" group. It is

recognized that in these families more than one child may be rheumatic and these children are especially susceptible to attacks of respiratory illness and other ailments.

Chronic disease in either the husband or the wife creates an atmosphere in the family which can be detrimental to the other members of the family, especially the children. One can hardly escape the conclusion that a child's reaction to the atmosphere created by a psychoneurotic parent is apt to be frequent illness. Otherwise, we should not expect such a high proportion of these families in the "sickly" group.

This small investigation has been used to illustrate the point that the usual indices of social and environmental conditions are not sufficient for a precise explanation of variations in illness. We must find more searching techniques for studying environmental influences in the production of ill health.

Summary

Economic status as expressed by annual income of the family is an important index of environment because it determines to a considerable extent the paucity or abundance of so many conditions conducive to healthful living: food, housing, medical care, education, and recreation. Yet the relationship of family income to *all illness* is clear-cut only for the very poorest, those with an annual income of less than $1,000. Part of the reason for this is because a relatively high proportion of *all illness* is composed of attacks of the acute respiratory illnesses and the acute infectious diseases, mainly those of childhood. For example, at ages under 15 these illnesses account for 60 to 70 per cent of the total; at ages 15–44, 50 per cent, and at ages 45 and over they account for 30 to 40 per cent of all illness(12). These illnesses generally do not select only those living under poor environmental conditions. They are fairly common to all population groups irrespective of their level of living.

However, when specific illnesses such as pneumonia, rheumatic fever, or tuberculosis are considered, their relationship to poor environment as defined by annual income is more

clear-cut. Undoubtedly, a poor environment tends to lower nonspecific resistance to these and other diseases and thus is an active factor in their production. Yet we do not know precisely the particular factor or factors responsible.

The relationship of family income to *all chronic disease* also is clear-cut only for the very poorest groups in the population. The probable explanation for this is entirely different from that of *all illness* and economic status. It is true that chronic disease affects a relatively high proportion of the middle and old-age population and persons with these conditions are evidently comon to all income groups. However, the chronic diseases may be in the process of development over a long period of time and thus their appearance may be one expression of an accumulation of past experience. Information on income as obtained in morbidity studies is related to one particular period of time; that is the present. It is recognized that our population is not static with respect to level of income. Some families with a present income of $2,500 per year may have been in a much lower income class over a period of years; some may have previously been in a higher income class. In a study of social and cultural factors in chronic disease and delayed recovery, Ruesch found that 45 per cent of the cases of delayed recovery were "static"; that is they had remained in the same social class over a period of time; 39 per cent were "climbers"—they had moved from a lower to a higher social class; and the remainder, 16 per cent, were "decliners" or "mixed" (13). To find out whether one type or level of social environment is more productive of the chronic diseases than another type will require either retrospective data on an entire study population or continued observation over a very long period of time.

It seems just to conclude that the study of morbidity in relation to the usual indices of social and environmental conditions is of value because such investigation indicates a particular part of the population most in need of public health and medical care. However, if preventive medicine is to function more fully in the control of morbidity, most of which is of un-

known etiology, more searching techniques must be employed for evaluating the precise influence of specific environmental conditions in the production of ill health.

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PHYSICAL IMPAIRMENTS AND SOCIO-ENVIRONMENTAL FACTORS

ROLLO H. BRITTEN

AS stressed in the past and in the discussions today, the measurement of health or of disability may be thought of in terms of three major approaches: mortality statistics, records of sickness, and assessment of physical status by medical examination. Thus the establishment of interrelations between health and socio-environmental factors must involve these three approaches. Hence the separation of subject matter under which I am to discuss physical impairments in relation to these factors.

There is a major overlap, however, between mortality and morbidity records on the one hand and physical examinations on the other. Chronic diseases in their more severe stages cause morbidity and ultimately death; yet they are often ascertainable on physical examination; and, in fact, their discovery is often the primary purpose of such examination. Conversely, the most usable data on incapacitating physical impairments have come from morbidity studies, such as the National Health Survey.

In view of the need for some line of demarcation, I have limited myself to that type of condition which is *normally* thought of as physical impairment (impaired vision, impaired hearing, orthopedic impairments, teeth defects, and a few conditions bordering on chronic disease, such as hernia, varicose veins, arterial thickening, valvular heart lesions); but, for data, I will rely on morbidity surveys as well as on medical examinations. The above types of impairments carry a precise meaning, with the possible exception of orthopedic impairments. By this type is meant permanent handicaps which deprive a person of the natural use of some portion of the skeletal system—or more simply, lost, crippled, paralyzed, or deformed parts of the body.

The material to be referred to has been limited essentially to

two sources: the National Survey and a special study of Physical Impairments of Adult Life. In the National Health Survey (1), particular inquiry was made as to the presence of blindness, deafness, and orthopedic impairments (described on the schedule as (a) loss of leg, arm, fingers, etc.; and (b) crippled, deformed, paralyzed). Information was asked as to parts of the body affected, cause, and appliances used. Whether or not the impairment was incapacitating was also determined. For the present purpose, the main value of these data lie in the record of *incapacitating* impairments in relation to employment status and family income. In the survey, a group of the population was identified as "unemployable," the schedule question being whether the person, if not employed or not seeking work, was prevented from doing so by physical or mental impairment. Discussions relative to this group are limited to the ages 15–64 years. Persons in institutions for the entire twelve months preceding the survey were excluded.

As a matter of fact, the institutionalized population was lost to a large extent from data based on the National Health Survey and entirely from those obtained in the special study of Physical Impairments of Adult Life. Nonetheless, the group is of vast importance as representing an extremely severe stage of disability, whether by disease or by impairment. Although it is hardly possible to assess the economic status of these persons separated from their families and sustained in large part at public expense, they would certainly be classified as still further removed from ability to earn a living than the "unemployable" group of the National Health Survey.

It is fitting that the second source of material to be discussed should be that analyzed for the Milbank Memorial Fund under Mr. Sydenstricker's direction, namely, the records of adult males given "health examinations" by the Life Extension Institute. Following a preliminary study by another speaker on this program (Dr. Dublin) (2), Mr. Sydenstricker undertook these studies to supplement mortality and morbidity data as measures of the health status of the population. There resulted

a series of papers which introduced this new concept of measuring health (3). One of these dealt specifically with physical examinations and occupational class. Following similar comparisons in England based on mortality statistics, occupational class was used directly as a measure of economic or social status.

The examinations forming the basis of these studies were a sample of those made by the Life Extension Institute for policy-holders as a part of the welfare program of insurance companies. (They were not, it is to be emphasized, examinations made to determine whether a person was eligible for insurance.) Hence the studies describe a group of people all of whom were able to be about. The material covered first (as differentiated from later) medical examinations of one hundred thousand native-white male policy-holders in forty life insurance companies by nine thousand physicians. The examinations were divided into two groups—those made in the "head" offices, primarily New York, and those made in the "field." For numerous reasons (larger numbers, a better distribution by occupational class, a wider concensus of medical judgement, if less thorough examinations), the data here discussed are confined to examinations made in the "field."

Occupations were classified into four groups, having from 14,000 to 50,000 examinations each, except the small agricultural group of 4,500. Such groupings were used, of course, in the absence of specific knowledge as to the income of the persons examined. There is a recognized bias in the data in the direction of higher than average economic status. To a large extent this bias has been overcome by treating these occupational classes separately; but within any one class there is a tendency for the figures to represent the relatively better off individuals; and furthermore, no group of unskilled workers could be isolated. Thus the range in economic level is less than that which would be found in the general population.

From an economic point of view, the two studies (Life Extension Institute examinations and the National Health Sur-

vey) were carried out in two very different periods. The former data were collected in the so-called prosperous 1920's; the latter was a by-product of the following depression. If one were establishing quantitative relations in the sense that the physicist or chemist thinks of them, the differing background of the two studies would be a serious drawback; but a major point is to be made that the comparisons are really not quantitative in that sense. The degree of the relation depends on the extent to which we isolate persons at one end of the economic scale; as we do so, however, the smaller becomes the group we are considering. There is a balance then between the proportion of people affected and the sharpness of the comparison.

An important statistical fact, which bears on the above point, is the relative frequency of impairments of differing degrees of severity. The less severe cases are greatly in the majority and hence, unless specifically excluded, they dominate any rate. Thus where impairments are counted regardless of severity, it is difficult fully to assess the association with economic status. Indeed, I find a certain unreality in speaking in terms of the frequency of impairments in the population (for instance, the number of persons with hernia or with arteriosclerosis); and when such rates are quoted in this discussion, it must be understood that the only purpose is to indicate relative differences in frequency between socio-economic groups.

I have endeavored to minimize these difficulties by showing for each a very severe degree, as well as some broader prevalence rates—blindness and impaired vision; deafness and impaired hearing; incapacitating and non-incapacitating orthopedic impairments. Also the emphasis will not be on the exact percentage differences, but on the fact that correlations do exist.

The two studies forming the basis of this talk do not employ the same index of economic status. Annual family income (obtained in broad groups and for other reasons not a precise measure of the real economic position of the individuals), em-

ployment status, color, and occupational class are used as rough measures of the same thing. Crowding or some other index of environmental factors could have been used. These criteria all point in the same direction and serve well our non-quantitative purposes.

This discussion being exploratory and suggestive of further research, there will be no attempt to burden you with references to other sources of data (4), but it is to be regretted that no clear-cut illustrations are available from our most ambitious program of medical examinations—the selective service and induction examinations. No analyses have been made, so far as I know, which will permit any adequate economic comparisons. About all that can be said at present is that the draft results (5) are not inconsistent with the indications of the Physical Impairments of Adult Life study.

It is a truism to say that incapacitating physical impairments result in a lowered economic status. A permanently disabled person cannot usually earn a living. Not only is his economic well-being affected, but so is that of other persons in his family, if any. Even though he would not have been a wage-earner if without an incapacitating impairment, it is manifest that an economic loss exists because of other activities, such as housekeeping, in which he (or she) cannot engage, and also because of the serious drain of invalid care. The tragic effect of physical impairments on the economic position of countless numbers of families is one which cannot be put into words, much less into statistics. Society has recognized this fact in increasing degree, as evidenced by Workmen's Compensation laws and then by Social Security programs for the blind and for crippled children.

The other side of the shield is the problem of physical impairment as a result of certain components of low economic status. This relation is not so simple, and the statistics are ambiguous. It is necessary to rely on other types of information, such as the known effect of malnutrition.

The defect of blindness is a good point of departure for a review of the association of physical impairments and socio-

environmental status because its incapacitating effect is so clearly recognized. Every one has come into contact personally with individuals who were blind in both eyes, and knows the terrible economic consequences involved. Seventy per cent of men, blind in both eyes, under 65 years of age, were classified as "unemployable" in the National Health Survey. To express the point from another angle, 3 per cent of persons classified as "unemployable" in the Survey were blind in one or both eyes. Most of the blind persons who were classified as employed could earn a living only in restricted ways, with varying degrees of help.

Although it would be expected that blindness in both eyes would manifest a sharp relation with economic status (and such was the case), it is interesting that blindness in one eye only showed a similar correlation of about the same degree. In both instances the rates in the group with annual family income under $1,000 were about four times those for the income group of $5,000 and over. There was a marked excess in the rates of the colored population over those in the white. In the South the rate per 100,000 for blindness in both eyes was 217 against 74; in the Northeast, 152 against 70; in the North Central, 207 against 81.

No categorical answer can be given as to the extent blindness appears as a cause of low economic status or as a result of it. The reaction goes both ways, and it is of most significance that, whether or not the blindness is associated in its origin with factors involving economic or environmental level, it acts as a deteriorating influence on such level. National Health Survey data gave some indications of the relative part disease and accident play in blindness. Much of this information is of value in pursuing this point, but time prevents giving the figures.

The proportion of persons with defective vision—we turn now to the study of Physical Impairments of Adult Life—was highest in the professional and business groups. Since less than normal in either eye by either the Snellen or Jaeger tests was

the criterion used, slight defects of vision naturally dominate the figures, and the picture is radically different from that for the extremely severe stage of blindness. The percentages (56 for professional; 51 for business; 43 for skilled trade; and 36 for agriculture) may indicate elements of selection or some effect of excessive use of the eyes.

Total or serious deafness bears a relation to economic status in the data of the National Health Survey, though during the productive ages the frequency is low. In the Physical Impairments of Adult Life study, defective hearing had considerably higher rates in the skilled trade group than in the relatively better off occupational classes. Rates in certain specific occupations suggested an occupational hazard.

Orthopedic impairments in particular have a serious effect on employment and income status. Only a few summary statements are needed on this point. Twenty-three per cent—nearly a quarter—of the "unemployable" persons in the National Health Survey were so classified by reason of orthopedic impairments. Accordingly, we would expect—and we find—that there was a marked relation between the prevalence of incapacitating orthopedic impairments and family income. For males the prevalence rate per 1,000 persons was 5.2 in the annual family income group of less than $1,000, as against 1.3 for incomes of $2,000 and more; for females the corresponding rates were 2.4 and 1.4. A similar relation was noted for non-incapacitating orthopedic impairments.

Since orthopedic impairments can hardly be thought of as a single entity, the make-up of the group should be described in general terms. Of the total prevalence rate of 19 per 1,000 persons, 7 per 1,000 were cases of lost members and 12 of impaired members. In both groups the persons with non-incapacitating impairments were in the majority, and the degree of this excess was naturally dependent on the thoroughness of coverage of the lesser impairments. As in the case of blindness, data were available on the relative proportion due to disease and to accident, and the causes in each of these groups. For the "un-

employables," the cause of the impairment was reported as "accident" in 47 per cent.

A critically important part of a person's environment from a health point of view is his housing, and has been so recognized by the Milbank Memorial Fund in its support of the Hygiene of Housing Committee of the American Public Health Association. As a matter of fact, that Committee is meeting with this Conference. It is not far-fetched to include under this discussion of orthopedic impairments, certain aspects of housing and health. Dilapidated structures offer an increased risk of accidents. In fact, the National Health Survey indicates that the rate of serious accidents (those disabling for a week or more) is higher as the rental goes down. In this survey data were available also as to the prevalence of orthopedic impairments resulting from home accidents. Even more important is the tendency for families with members having incapacitating impairments, whatever the cause, to slip down the economic scale and therefore into that type of housing where adequate care is difficult to provide.

Since the question of needs for further studies has been raised, I should like to mention the great enthusiasm with which persons in the housing field welcome any information on the effect of housing on health. A joint committee of the American Public Health Association and the National Association of Housing Officials, of which Mr. Bleecker Marquette is chairman, has outlined in detail the problems of studying these relations and is interested in the further development of techniques. If any group should project studies of health and environment, the work of this committee should be considered.

Although in this discussion occupational class has been employed as an index of socio-environmental level, it is clear that the data are based on rates in specific occupations and may therefore reflect specific hazards. Of course, a major factor in the environment is the occupation. As this subject receives special attention later in the program, it is desired only to call attention to the fact that accidents result in permanent impair-

ments as well as sickness or death. Indeed, the National Health Survey data on orthopedic impairments showed that among males 24 per cent of the incapacitating cases were occupational in origin, and 45 per cent of the non-incapacitating cases. The percentage was 12 for blindness in both eyes and 24 for blindness in one eye only. In view of this fact, it is of importance to bring out, with respect to their bearing on physical impairment, the problems of control of accidents in industry, and such related aspects as child labor laws, employment of women in industry, etc.

The lack of medical, nursing, and dental care is a contributory factor in the prevalence of physical impairment, and of course closely associated with other environmental factors, particularly low income. Teeth defects may be chosen as an example of the point. These defects, whatever other factors are involved, are obviously in many cases aggravated by neglect of dental care. In fact, it is entirely clear that high rates of prevalence in the low economic groups is a reflection of this fact. In the Physical Impairments of Adult Life study, excessive rates of carious teeth (including septic roots) and for pyorrhea were found in the skilled trade and agricultural groups, as against the business and professional. The percentages for carious teeth were, respectively, 17, 18, 12, and 10. For pyorrhea the four corresponding percentages were 10, 7, 5, and 4. Had this study included a group of the lowest economic class, the contrast would have been much greater.

Although the National Health Survey did not obtain a record of the prevalence of teeth defects, a supplementary study on dental care was made in Detroit and will serve to bear out the relation between prevalence of defects and amount of care. It was found that 42 per cent of professional persons had received dental care in one year (exclusive of extractions only), whereas for unskilled workers the percentage was 16. Of the professional persons, only 4.4 per cent reported that they had never been to a dentist, as against 16 per cent for unskilled workers.

The relation of a few other impairments to socio-environmental status should be mentioned. In the Health Survey, hernia showed perhaps a sharper relation to economic status than any other condition, including disease. The annual rate of disability in the group with annual family income of less than $1,000 was nine times that in the group with income of $3,000 or more. For varicose veins the ratio was 5 to 1. The study of Physical Impairments of Adult Life offers information on certain other conditions. Among those with definitely higher rates in the skilled trade group as against the business and professional were those for valvular heart lesions, enlarged heart, and arterial thickening.

I am always disquieted at presenting statistical facts which blunt the mind by reason of their abstract quality, which usually minimize disparities because they neglect quality, and which seem such a pale expression of the tragedies that lie behind them. It is easy to show that the blind are mostly unemployable; families are lowered in economic scale by reason of orthopedic impairments; many people do not receive adequate medical and dental care; the ratio of difference in prevalence by economic status can run as high as 9 to 1. But it will take imagination and understanding to get at the discouragement and despair behind these facts.

In spite of the ambiguous nature of available data on the association of physical impairments and socio-environmental factors, the following facts stand out:

1. Serious impairments result in lower economic status.
2. This relation is true even for impairments in a group of people able to be about.
3. To an important extent, the components of low economic status are causes of physical impairments, forming a vicious circle.
4. Certain elements in the environment are particularly significant in this connection, such as occupation, housing, nutrition, and insufficient medical care.

I feel deeply that every human being has certain inalienable

rights of opportunity which the present economic and racial disparities completely take away from many. It is to be doubted whether dealing only with symptoms will make adequate restitution. So I believe that social medicine must consider also the basic social, economic, and racial inequalities. This need is particularly important at a time when forces of incalculable power in this country are being brought to bear, for profit, against the rights of people and being supported overwhelmingly by the press. The standard of living of the mass of people is steadily deteriorating—even in a period of so-called prosperity—and the profits of a limited group are rising. And there is the threat of a depression. Meantime, abetted by these very forces, there is an ominously growing hysteria that can conceivably bring fascism to this country and perhaps even a war which will destroy everything for which we are working. International cooperation must be reestablished.

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SICKNESS AMONG INDUSTRIAL EMPLOYEES IN BALTIMORE IN RELATION TO WEEKLY HOURS OF WORK[1], 1941–1943

SELWYN D. COLLINS[2]

THE relation of long hours of work, particularly of a tedious and fatiguing character, to the health and efficiency of workers has been under investigation for many years. Studies during the World War of 1914–1918 by the British Committee on the Health of Munition Workers were so fundamental that they were reprinted in 1917 as bulletins of the United States Bureau of Labor Statistics (15, 16). During the World War of 1939–1945 further studies of this type were made by the British Industrial Health Board. The first report summarized the conclusions of the Committee studies on fatigue and environmental conditions during World War I and reviewed similar research between the two wars; the second report related to hours of work, time lost, and labor wastage during World War II (3).

These British studies during both wars set upper limits for hours per week beyond which it was considered inexpedient to permit work over an extended period. One of the memoranda has the following conclusion: "Excessively long hours of work, particularly by night, if continued, produce fatigue, irritation, and sickness", with a quotation from Sir James Paget ". . . that fatigue has a larger share in the promotion or permission of disease than any other single causal condition" (16d, p. 62). It was found in these studies that time lost by factory workers varied with the length of the work week, increasing as hours

[1] From the Division of Public Health Methods of the United States Public Health Service and the Milbank Memorial Fund. The Departments of Biostatistics and Epidemiology of the Johns Hopkins School of Hygiene and Public Health and the Baltimore City Health Department also cooperated in the general morbidity study on which this paper is based.

Special thanks are due to: Miss Jean Downes of the Milbank Memorial Fund who was in general charge of the morbidity study; Miss Ruth Phillips of the Public Health Service who was in immediate charge of the collection and tabulation of the data; and Mrs. Dorothy Oliver of the Public Health Service who assisted in numerous phases of the work.

[2] Head Statistician, United States Public Health Service.

increased from 60 to 75 per week (3). H. M. Vernon (19), writing in 1940, gives a summary of data on time lost in several munition factories during World War I which shows more days lost on account of sickness in factories working long hours than in short-hour plants.

Interest in fatigue of industrial workers in the United States also goes back at least to World War I, as evidenced by the reprinting of the British Reports (16) and early studies on fatigue in relation to working capacity (7). Some studies were made in the '30's but during the war years of the '40's investigations of this kind were greatly stimulated in both England and the United States. Such studies are too numerous to mention here but a few which include references to others are listed in the bibliography (2, 5, 6, 8, 9, 10, 12, 13, 14). Many of these studies were made from an economic point of view and include data on total absenteeism (sick and not sick) in relation to hours-of-work and efficiency; however, relatively few of them show data on time lost on account of sickness and injury in relation to hours of work. Moreover, the usual method involves a comparison of absenteeism for given factories during periods working long hours per week with rates for other periods with short hours per week; or for the same period to compare rates for factories working different hours per week. The present study considers individuals living in a certain area regardless of the place of work, and compares sickness rates for those working long hours with those working short hours.

Data and Type of Present Study

During a 5-year period ending in May, 1943, the Public Health Service and the Milbank Memorial Fund conducted a study of sickness in a sample of families in the Eastern Health District of Baltimore, Maryland. The study involved the visiting of each family once a month to record all illness which had occurred in the household since the preceding visit. Data were also recorded about wage-earners in the family, such as their earnings per week, and the occupations in which they were

engaged. These data did not include hours per week, but special data were collected by the field canvassers in the third quarter of 1942 for the purpose of studying illness among persons working varying hours per week. The period covered in this latter study was from January, 1941, to May, 1943, inclusive, or about the first two and one-half years of the war. It was necessary to record hours per week for each worker back some eighteen to twenty-one months to January, 1941, and then continue the record until the end of the study in 1943. The general morbidity study among these families had been in progress for several years and the informants were accustomed to giving confidential information to the field canvassers. Since the study involved monthly visits, doubtful items could be checked by the family informant with the worker himself and reported to the field canvasser at the next visit.

The new schedule contained, in addition to working hours per week, the following facts: weekly wage including regular and overtime; travel time to and from work; character of the work classified in terms of light, medium, and heavy; whether the individual worked in a nondefense plant or in one doing some defense work; and a review of occupational data, including years worked at the occupation at which last engaged.

The study was made entirely on information supplied at the household of the worker, usually the housewife being the informant not only for sickness but for hours of work and related plant data. Therefore, the fact that a worker was under observation throughout the study does not necessarily mean that he was working in the same plant or for the same company throughout the period, but merely that he was working at some plant of whatever particular category is under discussion.

The study was limited largely to wage earners. Professional workers such as doctors, teachers, and lawyers, were not considered except that family incomes include their income as well as that of any wage-earners in the family. Domestic workers were included if their hours were known; no workers were included for periods in which the hours per week were unknown.

Since the worker could be identified on the original family-census schedule and on the monthly illness record throughout the period of the study, no additional questions were asked about sickness, the new records for the worker being matched with the sickness records. There were considerable numbers of individuals working long hours in 1941 and others working short hours in 1943. Therefore, both the hour and the sickness records were tabulated in a way to relate the sickness which occurred during the study to the observed time for workers on long, medium, and short hours per week.

Change in Industrial Conditions Between 1941 and 1943

Before considering illness data in the different hours-of-work groups, it is of interest to examine some of the changes which took place between the first part of 1941 and the first part of 1943. In the study of illness, all workers were included whether they worked in the plant the whole time, or came in after January, 1941, or left the plant before 1943. However, for the purpose of comparing the situations of 1941 and 1943, the groups are limited to workers who were under observation and at work at some time during the first three quarters of 1941 (chiefly January-June, 1941) and were also under observation and at work at some time during the last three quarters of the study (October, 1942, to May, 1943, chiefly January–May, 1943). The data for this group who were generally at work throughout the study represent a comparison of two rather different economic situations with an approximate two-year interval between them.

There were 735 families with a known number of workers in both periods, each family having at least one worker in both years. In 1941 these families had an average of 1.75 gainfully occupied workers, as compared with 1.65 in 1943. However, when the considerable number of young persons in the armed forces in 1943 were counted as workers, the average workers per family in 1943 was 1.94.

Men in this group observed in both years, worked in 1941 an

average of 44.6 hours per week as compared with 48.9 for the same group in 1943. In 1941, 14 per cent of the men were working 50 or more hours per week as compared with 27 per cent in 1943. On the other hand, in 1941, 54 per cent were working 24–43 hours per week with 4 per cent under 35 hours; this may be compared with 21 per cent in 1943 for 24–43 hours, with only 1 per cent under 35 hours. The most common work week for this group in 1941 was 40 hours; the number of men working that time was 4 times the number at 44 hours and 2.4 times the number at 48 hours. In 1943 the most common work week was 48 hours with 2.5 times as many men as at 40 hours and 5 times as many as at 44 hours per week. Of all men workers in this group, 42 per cent reported a 48-hour week in 1943.

Corresponding data for women observed in both years show an average work week of 42.2 hours in 1941 as compared with 44.6 in 1943, or only a slight increase; in 1941, 7 per cent of the women were working 50 hours or more, as compared with 8 per cent in 1943. In 1941, 58 per cent of the women were working 24–43 hours per week, with 8 per cent under 35 hours; in 1943, 35 per cent were working 24–43 hours, with 3 per cent under 35 hours. Among women also the most common work week changed from 40 hours in 1941 to 48 hours in 1943, but the magnitude of the shift was less than for men. Of all women workers, 38 per cent reported a 48-hour week in 1943.

Of the 1,963 men and women workers, 43.4 per cent were working in defense plants in both 1941 and 1943, and 16.2 per cent went into defense plants at some time between 1941 and 1943 from nondefense plants and industries or agriculture or as new workers just out of school. The other 40.4 per cent were in other plants.

In 1941, the average hours per week in the two types of plants were about the same, 45.5 for the 359 men in nondefense plants and 43.6 for the 423 men in defense plants. In 1943 the 359 male workers in nondefense plants averaged 47.6 hours per week as compared with 49.6 hours for the 423 men who

were in defense plants in both 1941 and 1943, and 50.4 hours for the 145 men who went into defense work at some time during the study. In 1943, 19 per cent of the nondefense male workers were working 50 or more hours per week, as compared with 31 per cent for those who had been in defense plants throughout the period, and 34 per cent for those who had gone into defense during the study. No such striking differences were found in hours of work of women workers in the two types of plants.

Changes in weekly family incomes from the first to the last of the study are of interest. There were 375 families who were under observation in both 1941 and 1943 and whose incomes and the numbers of workers in the family were known for both periods; in this group the average family income per week was $38.38 in 1941, as compared with $55.21 in 1943[3].

In both 1941 and 1943 the great majority of the workers were on the day shift, with an alternating day and night shift as the next in frequency. Of the 915 men observed in both years and known as to the working shift, 74 per cent were on the day shift in 1943, 15 per cent on the alternating shift, 6 per cent on the "swing" or afternoon-evening shift, and 5 per cent on the night shift. The distributions according to shifts were similar in 1941; among the men 78 per cent were on the day shift as compared with 74 per cent in 1943.

Of the women in the same category, 86 per cent were on the day shift in 1943 with most of the others on the alternating and swing shifts. In 1941, 88 per cent of the women were on the day shift.

The distributions according to shifts were similar in 1943 for workers who came into the study to those for workers who were observed in both 1941 and 1943, with a tendency toward somewhat fewer on the day shift and somewhat more on the afternoon and night shifts.

Travel time to and from the plant was recorded for both

[3] There was a total of 571 families with known incomes in 1941, and 659 families with known incomes in 1943. Incomes computed on the basis of these families are practically identical with those for the group of families with known incomes for both periods.

periods. In 1941 travel time (one way) for men averaged 33 minutes as compared with 34 in 1943; in 1941, 27 per cent of the men reported a travel time of 45 or more minutes, as compared with 30 per cent in 1943. For some reason the travel time for women was less, averaging 26 minutes in 1941 and 27 in 1943; 12 per cent of the women required 45 or more minutes of travel time in both 1941 and 1943.

Age used in this study represents age last birthday at the end of 1942, or age nearest birthday at the middle of 1942. The average age of the 359 men who were in nondefense work throughout the study was 44.3 years, as compared with 39.4 years for the 423 men in defense work throughout the study. The 145 men who went into defense work at some time during the study averaged only 34.6 years of age. In these three groups the percentages of the male workers who were 45 years or over were as follows: nondefense work throughout, 49 per cent; defense work throughout, 35 per cent; and those who entered defense work, 24 per cent.

As is usually the case in industrial work, the average age of the women was considerably less than that of the men. Women in nondefense work throughout averaged 33.8 years, with 21 per cent who were 45 years of age or over, as compared with an average of 33.0 years for those who were in defense work throughout the study, with 15 per cent who were 45 years or over. Those who went into defense work during the study averaged 27.6 years of age with 7 per cent 45 years or over.

There was another group of workers who entered the study at some time after the first three quarters of 1941. As might be expected, ages of both males and females of this group as of the middle of 1942 were less than for the workers who were in the study throughout. Those workers of this group who entered defense plants had the lowest average age, 24.5 for men and 23.8 for women.

While many new persons entered the plants during the study, a large proportion of all workers had pursued their occupations for many years. Considering the occupation of the

worker on his last observed work the men who had been under observation in both 1941 and 1943 had worked at their last occupation for an average of 9.8 years and the women 7.7 years. Eighteen per cent of the men and 22 per cent of the women had pursued their occupations for less than one year, but 58 and 46 per cent of the men and women, respectively, had pursued their occupations for 4 years or longer.

The great majority of the persons who came into the study between 1941 and 1943 were new workers, averaging 3.5 and 1.7 years, for men and women, respectively, at the occupations pursued at the end of the study, with 53 and 69 per cent who had worked at these occupations for less than one year. However, even of this group, 21 per cent of the men and 12 per cent of the women had pursued their same occupations for four years or longer.

Methods of Classifying and Tabulating the Data

Several of the economic and environmental factors discussed in the preceding section may be related to illness. However, the number of workers and the total time under observation in this study were not large and it was impossible to take account simultaneously of all of the various factors associated with illness. To obtain an accurate figure for the population under observation with specified hours of work per week, it was necessary to code separately each month of observation for a given worker to show his hours for that month (or the major part of it), and his illnesses which began during that month. For example, a given worker between 1941 and 1943 may have worked part of the time at 40 hours a week, part at 44 hours, and still another part at 55 hours per week. For the purposes of this study, months of observation for a worker were classified into three groups as follows:

a. Long hours: 50 or more per week (average 59).
b. Medium hours: 44–49 per week (average 47).
c. Short hours: 24–43 per week (average 39).

Persons unemployed or working less than 24 hours per week

were excluded from the study for such time as that situation continued.

Cases of sickness during the period of observation were classified according to diagnosis and according to the severity of the illness as follows:

1. All recorded cases, including nondisabling and disabling.
2. Disabling cases, including all which caused 1 or more days loss from work.
3. Bed cases, including disabling illness which also confined the patient to bed for 1 or more days.

A supplementary classification which cuts across the above categories includes:

4. All cases attended by a physician, clinic, hospital, or other practitioner.
5. Disabling cases attended by a physician, clinic, hospital, or other practitioner.

Disabling cases of illness refer to periods of inability to work at the usual job on account of either an acute, chronic, or recurring disease. Injuries are included along with sickness. Total recorded cases include nondisabling and disabling cases of illness and injury.

For the most part, rates are shown separately for male and female workers. Of all months of observation for this study, approximately 70 per cent were for men and 30 per cent for women. Rates for both sexes represent weighted averages of the rates for the two sexes, with a weight of 7 for males and 3 for females. Thus all rates for both sexes are adjusted to this standard and fluctuations due to varying proportions of men and women in the different groups are eliminated.

The fact that this study covers a period of two and one-half years with case rates computed for the whole period for long, medium, and short-hour workers makes it possible for differences in general morbidity rates from year to year and differences in the numbers of persons under observation from month to month to result in a bias in the rates which might be mis-

taken for a true variation. To avoid this possibility, the data for each of the four quarters were assembled separately and rates computed for each quarter. With the exception of data for days lost from work, the rates all represent simple averages of four quarterly rates each computed on an annual basis. The first quarter, January–March, includes observations during the first quarter of each of the three years; the same is true of the second quarter, but the third and fourth quarters include only the first two years because the study stopped in the middle of 1943. Although this process of adjusting for seasonal variation was a safeguard, a comparison of the crude rates based on all of the data combined shows only small differences from the adjusted rates.[4]

Relation of Illness to Hours of Work

Case Incidence, All Causes. Figure 1 shows by sex the case rates from all causes for each of the five severity categories (Tables 1 and 5). It is seen that sickness rates for women increase regularly as hours of work increase. For example, disabling illness computed on an annual basis amounted to 564 cases per 1,000 women working short hours, and increased regularly to 951 for those working long hours. This consistent increase for women is true for all five severities of illness shown in Figure 1. For men the case rates for the short-hour group are consistently less than those for the long-hour group, but in four of the severity categories the medium-hour group had a slightly lower rate than the short-hour group. For example, the disabling illness rate for the short-hour group was 401 cases per 1,000, for medium hours 380, and for the long-hour group 568.

The paucity of available data made it impossible to use

[4] Considering rates for males from all causes for each of the 10 quarter-years covered by the study, in 9 quarters rates for either the short or medium-hour group were less than for the long-hour group, and in 7 of those quarters both were less than the long-hour rate. For respiratory diseases in all 10 quarters the rates for either the short or medium-hour group were less than for the long-hour group. There were only about half as many women as men workers so rates for women were not computed for each year separately, but in general rates for women workers were more closely related to hours per week than was true of men.

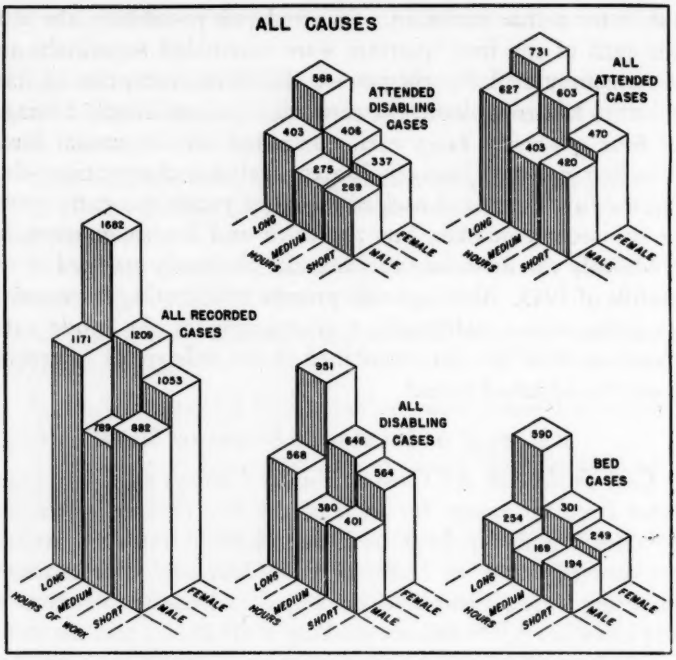

Fig. 1. Annual illnesses of various types from all causes per 1,000 workers of specified hours of work—Baltimore, 1941–1943. (Hours of work per week: Long, 50 or more; medium, 44–49; short, 24–43.)

detailed ages. However, there was sufficient observation time to warrant classifying each group into the ages 15–29 and 30–44. Figure 2 and Table 2 show by sex in these two ages the frequency of disabling illness from all causes among workers classified according to hours per week. Among persons 15–29 years of age the disabling case rates for both men and women increase consistently with increasing hours of work. Disabling case rates for women in the short-hour group were 542 per 1,000 as compared with 784 in the long-hour group; corresponding rates for men were 332 and 612, respectively. For both men and women of the ages 30–44 years, rates in the long-hour group were about twice those in the short-hour

Table 1. Annual case rates[1] among white employed workers of all ages classified according to working hours per week—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[2] and Sex	Annual Case Rates[1] per 1,000 Workers (Corrected for Season)						Number of Cases					Population (Years of Life)
	All Causes	Diseases			Accidents		Diseases			Accidents		
		Minor Respiratory	Digestive	All Other	All	Industrial	Minor Respiratory	Digestive	All Other	All	Industrial	
DISABLING[3] CASES												
Both Sexes[4]												
Long	683	282	95	206	100	62	163	48	96	54	38	576.2
Medium	460	224	49	130	57	21	306	66	173	75	29	1326.0
Short	450	171	56	176	47	24	239	76	240	65	32	1331.8
Male												
Long	568	272	74	133	89	66	141	38	68	46	34	503.7
Medium	380	192	47	89	52	20	180	43	81	47	19	911.7
Short	401	155	54	154	38	25	141	47	136	33	22	874.4
Female												
Long	951	304	144	377	125	54	22	10	28	8	4	72.5
Medium	646	299	55	224	68	24	126	23	92	28	10	414.3
Short	564	207	63	226	68	22	98	29	104	32	10	457.4
BED CASES[5]												
Both Sexes[4]												
Long	355	170	44	116	25	20	93	24	44	14	10	576.2
Medium	209	121	21	52	15	4	166	28	70	19	6	1326.0
Short	210	93	28	77	12	5	130	38	104	16	6	1331.8
Male												
Long	254	148	39	45	23	15	77	20	23	12	8	503.7
Medium	169	99	22	35	14	4	93	20	31	12	4	911.7
Short	194	83	28	76	7	5	75	24	66	6	4	874.4
Female												
Long	590	222	56	282	29	29	16	4	21	2	2	72.5
Medium	301	173	19	92	17	4	73	8	39	7	2	414.3
Short	249	116	30	80	22	5	55	14	38	10	2	457.4
ALL RECORDED CASES												
Both Sexes[4]												
Long	1324	598	137	386	202	134	341	71	189	115	86	576.2
Medium	915	487	74	244	110	57	662	99	325	145	75	1326.0
Short	933	456	86	296	95	54	623	116	399	127	69	1331.8
Male												
Long	1171	568	112	287	204	163	291	57	144	102	81	503.7
Medium	789	431	70	192	96	50	401	64	175	86	46	911.7
Short	882	425	82	281	93	67	378	72	246	81	58	874.4
Female												
Long	1682	671	196	619	196	66	50	14	45	13	5	72.5
Medium	1209	618	83	365	144	72	261	35	150	59	29	414.3
Short	1053	527	96	332	98	24	245	44	153	46	11	457.4

[1] To correct for the varying seasonal distribution of the exposed populations, these annual rates represent a simple average of rates (annual basis) for the 4 quarters of the year.

[2] Long = 50 or more hours per week (average: men 59.3, women 55.2); medium = 44–49 hours (average: men 47.1, women 46.8); short = 24–43 hours (average: men 39.1, women 38.2). Persons working less than twenty-four hours per week are not counted as employed.

[3] Disabling cases refer to those causing one or more days lost from work.

[4] All computations of rates were done for males and females separately; the rates for both sexes represent a weighted average of the rates for the two sexes, the weights (7 and 3) bing proportional to the years of life observed for males and females, respectively.

[5] Bed cases refer to those confined to bed for one or more days.

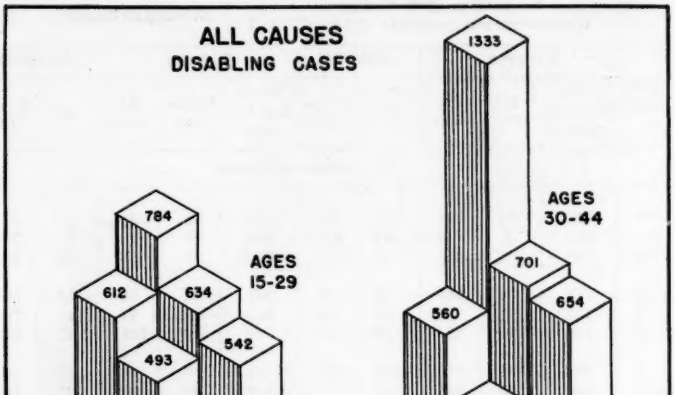

Fig. 2. Annual illnesses from all causes per 1,000 workers of two age groups of specified hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

group. However, the number of women working long hours was small so the rate for that group is not reliable.[5]

Mention has already been made of industrial plants engaged in defense work. Data were not available to make a detailed classification according to the work in these plants or according to departments in which defense work was done. Therefore, in this study defense work means merely that the plant in which this individual was employed was doing some defense work under government contract and in view of the urgency of the work, might be expected to show more speedup than in nondefense plants. When observation time was computed for each month, there ceased to be any group that "entered defense

[5] Since the data were insufficient for bringing age into more detailed comparisons,

(Continued on page 412)

work" inasmuch as the person's observation time was counted as in a defense plant from the time he began work in that plant and counted as nondefense work for previous time observed.

Table 2. Annual case rates[1] from respiratory and nonrespiratory causes among white employed workers of specified ages classified according to working hours per week—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[2] and Causes of Illness	Annual Case Rates[1] Per 1,000 Workers (Corrected for Season)									Number of Cases			
	Both Sexes			Male			Female			Male		Female	
	Ages			Ages			Ages			Ages		Ages	
	15–44[5]	15–29	30–44	15–44[5]	15–29	30–44	15–44[5]	15–29	30–44	15–29	30–44	15–29	30–44
	Disabling[3] Cases												
All Causes													
Long	728	664	792	586	612	560	1058	784	1333	92	118	29	23
Medium	491	535	448	416	493	339	667	634	701	139	117	147	98
Short	414	395	433	335	332	338	598	542	654	63	98	105	111
Minor Respiratory Diseases													
Long	289	282	296	278	312	245	313	212	414	47	52	9	7
Medium	246	254	238	214	249	179	321	266	376	71	63	62	53
Short	163	175	152	137	152	123	224	228	220	29	36	45	38
All Other Causes													
Long	439	382	496	308	300	315	745	572	919	45	66	20	16
Medium	245	281	210	202	244	160	346	368	325	68	54	85	45
Short	251	220	281	198	180	215	374	314	434	34	62	60	73
	All Recorded Cases												
All Causes													
Long	1364	1276	1451	1228	1199	1256	1682	1456	1908	179	258	54	33
Medium	948	965	931	811	903	719	1268	1109	1426	255	246	258	200
Short	886	878	894	808	812	804	1069	1033	1105	151	232	200	187
Minor Respiratory Diseases													
Long	584	599	569	567	576	558	625	654	596	87	116	26	10
Medium	503	486	520	434	463	405	664	538	789	132	140	126	112
Short	446	472	420	408	434	381	537	562	512	81	110	110	87
All Other Causes													
Long	780	677	882	661	623	698	1057	802	1312	92	142	28	23
Medium	445	479	411	377	440	314	604	571	637	123	106	132	88
Short	440	406	474	400	378	423	532	471	593	70	122	90	100
	Population (Years of Life)												
Years of Life													
Long	408.8	184.1	224.7	354.9	148.0	206.9	53.9	36.1	17.8	—	—	—	—
Medium	990.3	515.7	474.6	619.6	282.0	337.6	370.7	233.7	137.0	—	—	—	—
Short	831.9	376.1	455.8	472.9	185.1	287.8	359.0	191.0	168.0	—	—	—	—

[1, 2, 3, 4] *See* these notes on Table 1.

[5] Rates for ages 15–44 are simple averages of rates for 15–29 and 30–44.

Few workers in defense plants changed to nondefense work during the study.

Figure 3 and Table 3 show for both sexes case rates from all causes for all recorded illness and for disabling illness among workers in defense and nondefense plants. For both types of illness the workers in defense plants show a consistent rise as the hours of work increase. In nondefense plants the long-hour group shows higher rates than either the intermediate or short-hour group but the rates for the short-hour group are somewhat above those for the intermediate group. In the

the possible effect of age differences in the populations in the three hours-of-work groups should be examined.

Relative age distribution of workers (years of life) in each hours-of-work group.

Hours of Work and Sex	Mean Age of Workers	All Ages (Years of Life)		Percentage Distribution of Population (Years of Life)		
		Number	Per Cent	15–29	30–44	45 and Over
Male						
Long	37.1	503.7	100	29.4	41.1	29.5
Medium	36.8	911.7	100	31.0	37.0	32.0
Short	41.0	874.4	100	21.2	32.9	45.9
Female						
Long	31.5	72.5	100	49.8	24.5	25.7
Medium	28.6	414.3	100	56.4	33.1	10.5
Short	33.2	457.4	100	41.8	36.7	21.5

Long = 50 or more hours per week (average: men 59.3, women 55.2); medium = 44–49 hours (average: men 47.1, women 46.8); short = 24–43 hours (average: men 39.1, women 38.2). Persons working less than 24 hours per week are not counted as employed.

Age nearest birthday as of the middle of 1942; means here recorded represent a weighted average of the mean ages of workers in a given hour group at the first and at the last work covered by the study, the weights being proportional to the number of workers in the given group at the two dates.

Age is recorded as nearest birthday at the middle of 1942. Males in the short-hour group averaged 41.0 years, as compared with 36.8 for the intermediate group and 37.1 for the long-hour group. Age distributions of males also indicate that there were more older persons in the short than the long-hour group. However, an examination of the case rates at 15–29 and 30–44 years (Table 2) indicates relatively little variation with age, even including the age group 45 and over which is not shown in the table. The same thing is true of females except for the one high rate for ages 30–44 which is based on a small population. In view of these facts, it did not seem worth while to adjust the rates for age differences in the populations. Rates in Table 2 for 15–44 years are the equivalent of adjusted rates, inasmuch as they represent simple averages of rates in the two age groups.

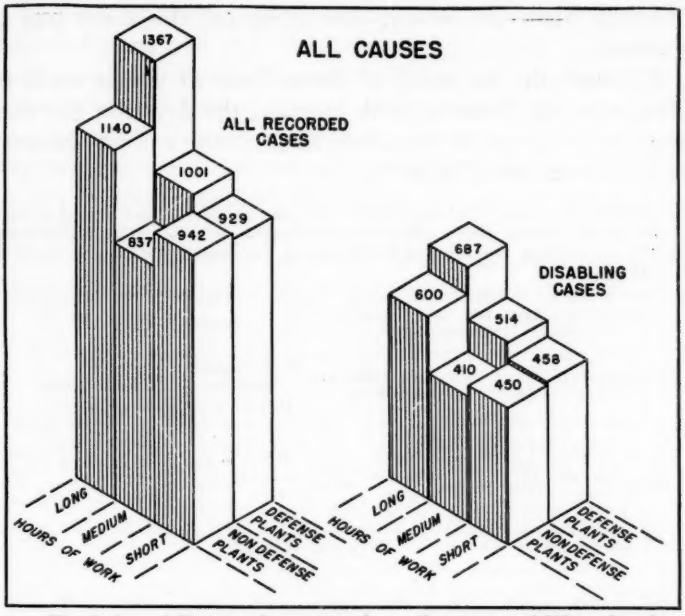

Fig. 3. Annual illnesses of two types from all causes per 1,000 workers in defense and nondefense plants, by hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

short-hour group there is little difference between illness in defense and nondefense plants but the medium and long-hour groups show higher rates in defense plants.

Days Lost from Illness, All Causes. Thus far the only measure of illness used has been case incidence, that is, the number of cases arising among workers with given hours per week, per 1,000 full-time years of life for the same group. Of equal importance are rates based on days lost from work, days in bed, and doctors' calls per 1,000 workers.

With respect to days lost from work, it is seen in Table 7 that among both males and females the medium and short-hour groups have lower rates from all causes than the long-hour group, but the short is above the medium-hour group. Among women the days confined to bed per 1,000 workers is

definitely higher in the long-hour group but this is not true of the men.

Although the frequency of illness from all causes tends to increase as the hours of work increase, the days lost per case tend to be larger in the short-hour group and to decrease as hours increase (Table 4).

Table 3. Annual case rates[1] from respiratory and nonrespiratory causes among white employed workers of all ages in defense and nondefense establishments, classified according to working hours —data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[2] and Sex	Annual Case Rate[1] Per 1,000 Workers (Corrected for Season)						Number of Cases				Population (Years of Life)	
	Establishments Doing Some Defense Work			Other Establishments (Nondefense)			Establishments Doing Some Defense Work		Other Establishments (Nondefense)			
	All Causes	Minor Respiratory	All Other	All Causes	Minor Respiratory	All Other	Minor Respiratory	All Other	Minor Respiratory	All Other	Defense Establishments	Nondefense Establishments
	Disabling[3] Cases											
Both Sexes[4]												
Long	687	283	405	600	220	380	127	136	36	62	393.9	182.3
Medium	514	275	239	410	166	244	205	170	101	144	761.1	564.9
Short	458	173	284	450	182	267	128	206	111	175	728.3	603.5
Male												
Long	635	329	306	403	131	272	121	112	20	40	358.0	145.7
Medium	394	220	174	356	143	213	132	102	48	69	583.5	328.2
Short	391	130	262	416	195	221	72	139	69	77	530.9	343.5
Female												
Long	809	174	635	1060	428	632	6	24	16	22	35.9	36.6
Medium	793	403	390	537	221	316	73	68	53	75	177.6	236.7
Short	612	275	336	528	154	374	56	67	42	98	197.4	260.0
	All Recorded Cases											
Both Sexes[4]												
Long	1367	589	778	1140	535	605	250	275	91	100	393.9	182.3
Medium	1001	551	450	837	422	415	411	323	251	246	761.1	564.9
Short	929	471	458	942	445	498	345	334	278	308	728.3	603.5
Male												
Long	1301	636	665	852	399	453	232	237	59	66	358.0	145.7
Medium	810	455	355	752	388	364	271	206	130	119	583.5	328.2
Short	871	422	448	899	429	470	227	238	151	161	530.9	343.5
Female												
Long	1520	479	1041	1813	854	959	18	38	32	34	35.9	36.6
Medium	1445	773	672	1035	501	534	140	117	121	127	177.6	236.7
Short	1064	584	480	1044	481	563	118	96	127	147	197.4	260.0

[1, 2, 3, 4] *See* these notes on Table 1.

It has already been seen that for all causes of sickness, all recorded cases and also disabling cases attended by a doctor show the same tendencies toward higher rates for the long-hour group. In Table 5 it is seen that doctors' calls per 1,000 workers were also larger in the long-hour group. However, doctors' calls per attended case were higher in the short-hour group, in agreement with the similar finding for days lost per disabling case.

While this study considers only illness and injury, the days charged to other causes are of interest because short absences of this kind sometimes get charged to sick leave and short and minor illnesses sometimes get charged to nonsick leave. In Table 6 causes other than illness are classified into two categories—vacation with advance approval, and days off without advance approval. As might be expected, there were

Table 4. Days lost from work per case of disabling illness[1] and the proportion of all recorded cases that were disabling among white employed workers of all ages classified according to working hours per week—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[2] and Sex	Days of Disability[1] Per Disabling Case						Percentage of All Recorded Cases That Were Disabling[3] for 1 or More Days					
		Diseases			Accidents			Diseases			Accidents	
	All Causes	Minor Respiratory	Digestive	All Other	All	Industrial	All Causes	Minor Respiratory	Digestive	All Other	All	Industrial
Both Sexes												
Long	10.1	8.2	8.5	11.0	15.4	12.6	50.4	47.8	67.6	50.8	47.0	44.2
Medium	10.5	6.0	15.3	15.1	14.3	12.9	50.4	46.2	66.7	53.2	51.7	38.7
Short	12.4	6.7	16.2	16.5	13.4	15.6	49.0	38.4	65.5	60.2	51.2	46.4
Male												
Long	10.3	8.6	9.4	10.4	15.8	13.0	49.3	48.5	66.7	47.2	45.1	42.0
Medium	11.4	6.4	17.2	16.4	16.5	12.8	48.3	44.9	67.2	46.3	54.7	41.3
Short	13.0	6.8	14.6	18.3	15.6	15.9	45.0	37.3	65.3	55.3	40.7	37.9
Female												
Long	9.1	5.4	4.8	12.6	13.0	9.5	55.7	44.0	71.4	62.2	61.5	80.0
Medium	9.4	5.4	11.7	13.8	10.7	13.2	53.3	48.3	65.7	61.3	47.5	34.5
Short	11.5	6.6	18.7	14.2	11.2	15.0	53.9	40.0	65.9	68.0	69.6	90.9

[1] Days of disability refer to time lost from work on account of illness or accident causing loss of one or more days. No adjustment was made for season.

Rates for both sexes are computed like those for each sex and not by an average of the two rates.

[2, 3] *See* these notes to Table 1. For the numbers of cases, days of disability, and details about what they include, *see* tables 1 and 7.

no significant or consistent differences, either for men or women, between short and long-hour workers with respect to days of vacation. On the other hand, the loss of time without advance approval is less in the short-hour group; among men the loss for short-hour workers was 572 days per 1,000 rising consistently to 1,096 days in the long-hour group. Among women there was a similarly consistent rise from 1,244 per 1,000 workers in the short-hour group to 1,807 in the long-hour group. Thus possible confusion between minor illness and absences from causes other than sickness would not distort the apparent relationship of sickness to hours of work because both categories show the same type of relationship.

Few data have been found in the literature on cases of

Table 5. Attended illnesses[1] from all causes and medical care among white employed workers of all ages classified according to working hours per week—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[2]	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
	Annual attended cases per 1,000 workers			Annual calls by doctors per 1,000 workers			Calls per attended case		
Long	658	627	731	2168	2329	1793	3.7	3.9	2.7
Medium	463	402	603	1366	1279	1569	3.2	3.4	2.9
Short	435	420	470	1610	1664	1484	4.0	4.3	3.5
	Annual attended disabling cases per 1,000 workers			Per cent of disabling cases that were attended			Number of attended[3] cases		
Long	458	403	588	69.3	71.0	61.8	369	316	53
Medium	314	275	406	68.2	72.4	62.8	617	367	250
Short	289	269	337	64.0	67.2	59.7	582	367	215

[1] Attended illness includes all cases with the care of a physician, hospital, or clinic, and a few attended by non-medical practitioners. Cases attended by a nurse alone are excluded except where the nurse was in a clinic or a physician's office.

[2] Long = 50 or more hours per week (average: men 59.3, women 55.2); medium = 44–49 hours (average: men 47.1, women 46.8); short = 24–43 hours (average: men 39.1, women 38.2). Persons working less than 24 hours per week are not counted as employed.

[3] For total and disabling cases (attended and nonattended) and population observed, *see* Table 1.

illness among persons working different hours but a number of publications give days lost from all causes (sick and not sick) and a few of these give rates (or data from which rates can be computed) for days lost on account of sickness.

In a study of women's work hours (18, pp. 108–128) in a United States aircraft plant in 1943–1944, data on days lost from work are shown for one large plant for periods of four weeks each in which the hours of work varied from a 48 to a 60–hour week. In periods of four weeks each the hours lost from work on account of illness and injury per 100 man-hours of possible work are computed to be as follows: 60–hour week, 14.9 per cent; 50–54 hour week, 9.0 per cent; 48–hour week, 7.0 per cent.

In an earlier study of 2,214 women (17, pp. 79–82), similar data can be computed in terms of days lost on account of sickness and injury per worker during an annual period in

Table 6. Annual days lost from work on account of causes other than illness and injury among white employed workers of all ages classified according to working hours per week—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[1]	Total Days Lost, Not Sick			Vacation Approved in Advance			Off Duty Without Advance Approval		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
	Annual days lost (not sick) per 1,000 workers[2]								
Long	4666	4201	5752	3357	3105	3945	1309	1096	1807
Medium	4293	3839	5351	3300	3101	3765	992	738	1586
Short	4636	4468	5028	3863	3896	3784	773	572	1244
	Number of days lost (not sick)								
Long	2533	2116	417	1850	1564	286	683	552	131
Medium	5717	3500	2217	4387	2827	1560	1330	673	657
Short	6207	3907	2300	5138	3407	1731	1069	500	569

[1] Long = 50 or more hours per week (average: men 59.3, women 55.2); medium = 44–49 hours (average: men 47.1, women 46.8); short = 24–43 hours (average: men 39.1, women 38.2). Persons working less than twenty-four hours per week are not counted as employed. For population (years of life) for each category, *see* Table 1.

[2] No correction for season. Other rates were changed very little by the seasonal correction.

cotton mills working different hours as follows: 55 or more hours per week, 16.0 days lost; 49–54 hours, 8.4 days lost; 48 hours, 7.0 days lost.

The following data quoted by many authors represent the percentage of total possible work time that was lost on account of sickness during World War I in three munition factories of England during periods with different hours per week (9, 12, 19):

Hours of Work per Week	*Percentage of Total Possible Work Days That Were Lost on Account of Sickness*	
	Men	*Women*
63¼	7.0	—
62	5.7	6.4
54	4.0	4.3
44	—	3.1

Incidence of Minor Respiratory and Other Diseases. In this as in other morbidity studies, the minor respiratory[6] diseases are the greatest single cause not only of cases but also of days lost from work on account of illness and accident. Of all disabling cases, 44 per cent were minor respiratory, and of all days disabled, 27 per cent were due to the minor respiratory diseases. Of all cases confining the patient to bed for one or more days, 52 per cent were minor respiratory, and 31 per cent of the days in bed were due to minor respiratory diseases. As Lanza (11) has pointed out, the minor respiratory diseases usually represent a total loss even to an insured employee because so few cases are disabled as long as the usual waiting period of seven days before benefits are payable. Other reports have emphasized the great importance of the respiratory diseases in industry (1, 4).

Figure 4 shows case rates for minor respiratory diseases classified by severity into all recorded cases, disabling cases, and bed cases (Table 1). It is seen that for this important

[6] Minor respiratory diseases as here tabulated include: colds, coryza, rhinitis, pharyngitis, tonsillitis, laryngitis, sore throat, bronchitis, influenza, grippe, and similar affections of the upper respiratory tract.

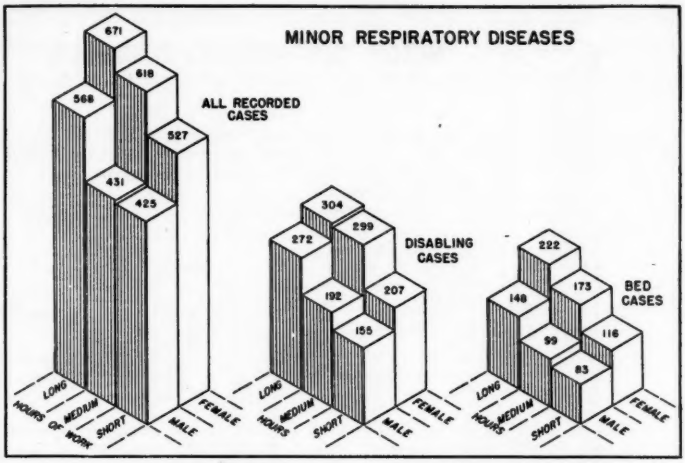

Fig. 4. Annual illnesses of three types from minor respiratory diseases per 1,000 workers of specified hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

category of illness the long-hour group for each sex has consistently higher case rates than the short and intermediate groups. Figure 5 and Table 7 show for these minor respiratory diseases classified in the same way the annual days lost from work and the days confined to bed per 1,000 workers. Here again the long-hour group has consistently higher rates than the short-hour group and with one exception the intermediate-hour rate falls between those for long and short-hour workers.

Of all days lost from work on account of disease and accident, 37 per cent in the long-hour group were due to minor respiratory diseases, 28 per cent among medium-hour workers, and 21 per cent for short-hour workers.

Figure 6 shows sickness rates from minor respiratory diseases and all other causes (including accidents) in two broad age groups for both sexes combined (Table 2). It is here seen that in both age groups the long-hour workers have the highest rates for both broad causes. In three out of the four categories, the short-hour group has the lowest rate and the long-hour group the highest rate.

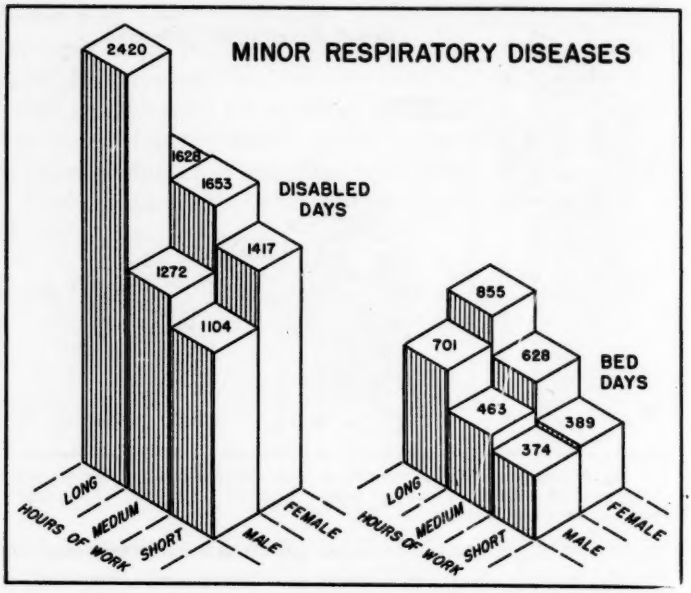

Fig. 5. Annual days lost from work and days confined to bed from minor respiratory diseases per 1,000 workers of specified hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

Minor respiratory case rates for workers in defense and nondefense plants are shown in Figure 7 and Table 3 in a similar way to rates for all causes in Figure 3. As found for all causes of illness, minor respiratory rates among workers in defense plants are generally higher than those in nondefense plants. In both types of plants minor respiratory rates are higher among long-hour workers than among those working short hours.

The causes of illness other than minor respiratory diseases were classified into three groups: minor digestive, all other diseases, and all accidents (Table 1). Figure 8 shows case rates for each of these groups for all recorded cases, disabling cases, and bed cases. In the two disease groups one does not get the same consistent increase with lengthening of the work week as appeared in minor respiratory attacks, but rates for the long-

hour group are rather consistently higher than those in the short-hour group. Although the accident rates are not high, they increase rather consistently as hours of work per week

Table 7. Annual days of disability[1] and confinement to bed among white employed workers of all ages classified according to working hours per week—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Hours of Work[2] and Sex	Annual Days of Disability[1] and Confinement to Bed Per 1,000 Workers						Number of Days of Disability and Confinement to Bed				
	All Causes	Diseases			Accidents		Diseases			Accidents	
		Minor Respiratory	Digestive	All Other	All	Industrial	Minor Respiratory	Digestive	All Other	All	Industrial
	DISABLED DAYS										
Both Sexes											
Long	6757	2182	698	2439	1438	772	1337	407	1059	829	480
Medium	4906	1387	762	1944	812	282	1845	1008	2605	1075	375
Short	5708	1198	904	2958	648	379	1613	1228	3961	874	500
Male											
Long	5976	2420	713	1404	1439	878	1219	359	707	725	442
Medium	4394	1272	812	1460	850	267	1160	740	1331	775	243
Short	5323	1104	783	2847	589	400	965	685	2489	515	350
Female											
Long	8579	1628	662	4855	1434	524	118	48	352	104	38
Medium	6099	1653	647	3075	724	319	685	268	1274	300	132
Short	6607	1417	1187	3218	785	328	648	543	1472	359	150
	DAYS CONFINED TO BED										
Both Sexes											
Long	1852	747	237	753	114	97	415	145	291	66	54
Medium	1446	512	267	606	60	19	682	352	812	81	26
Short	1693	379	299	891	125	71	505	409	1185	171	96
Male											
Long	1404	701	262	326	115	91	353	132	164	58	46
Medium	1261	463	301	455	43	9	422	274	415	39	8
Short	1617	374	242	902	98	65	327	212	789	86	57
Female											
Long	2897	855	179	1752	110	110	62	13	127	8	8
Medium	1875	628	188	958	101	43	260	78	397	42	18
Short	1871	389	431	866	186	85	178	197	396	85	39

[1] Days of disability here refer to days lost from work on account of illness or accident causing loss of one or more days. Days lost include the total days lost for cases with onset of disability during the time that the individual was working the given hours per week. Since the days of disability for a given case may have occurred in more than one quarter of the year, no correction has been made for seasonal variation in the populations exposed to risk.

For populations *see* Table 1.

[2] Long = 50 or more hours per week (average: men 59.3, women 55.2); medium = 44–49 hours (average: men 47.1, women 46.8); short = 24–43 hours (average: men 39.1, women 38.2). Persons working less than twenty-four hours per week are not counted as employed.

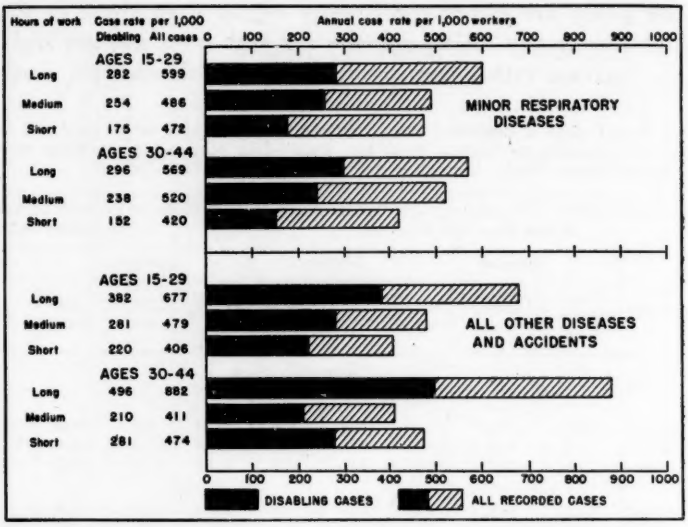

Fig. 6. Annual illnesses of two types from minor respiratory and from all other causes per 1,000 workers of two age groups and of specified hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

increase. Reference to Table 1 indicates that there is not much difference between total accident rates for men and women, but the rates for accidents causing loss of time from work are rather consistently higher for women. Accident rates as shown in Figure 8 include both industrial and nonindustrial, but Table 1 shows industrial accidents in a separate category.

Discussion of Results

It has been seen that a reasonably accurate count of the months in which the workers were on long, medium, and short-hour shifts, together with the illnesses that occurred during those periods, gives sickness rates that rather consistently increase from a low incidence in the short-hour group to rather high rates in the long-hour group, with the intermediate group usually falling between the two extremes. When the picture varied from this pattern it was usually that the long-hour group

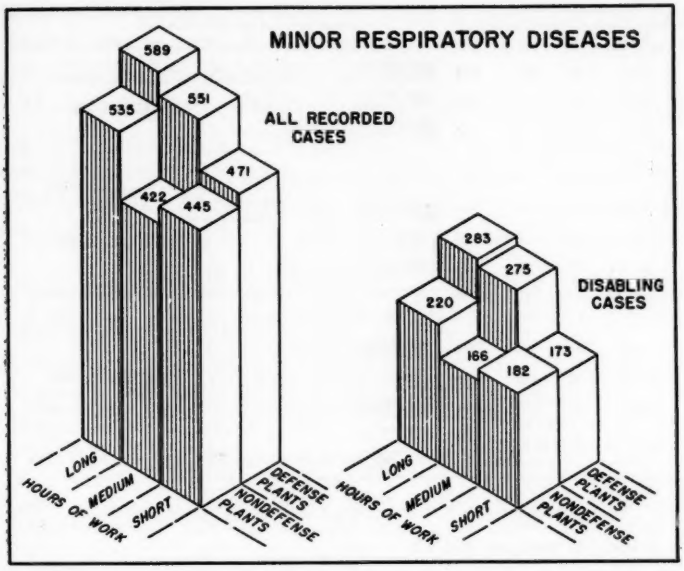

Fig. 7. Annual illnesses of two types from minor respiratory diseases per 1,000 workers in defense and nondefense plants, by hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

had rates consistently above both the medium and the short-hour groups, although the short may have had a higher sickness rate than the medium-hour group.

Age and sex differences in the distribution of the workers do not seem to be important factors in this result. The chief question that arises is whether there are other factors closely associated with hours-of-work which are the real causes of the higher illness rates among long-hour workers. One factor of possible importance is the income of the worker and his family. Average incomes per worker are available for the first (1941) and last (1943) work of persons covered by the study. A weighted[7] average of these two average incomes gives the following re-

[7] Weights for the respective groups were proportional to number of workers at the beginning and at the end of the study. Considerably larger differences in income existed at the end than at the beginning but the trends were the same for both periods.

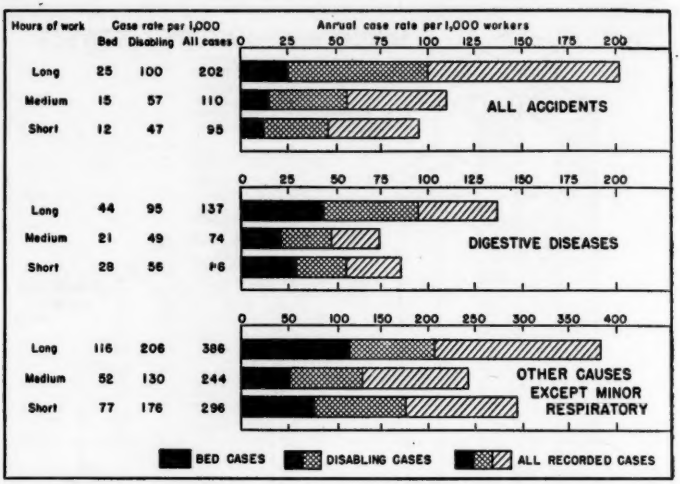

Fig. 8. Annual illnesses of three types and for certain diagnoses per 1,000 workers of specified hours of work—Baltimore, 1941–1943. (For actual hours of work per week, *see* Fig. 1.)

sults: Long-hour, $34.56 per week; medium, $30.84 per week; and short-hour, $25.88 per week. Thus the long-hour workers had the highest average wage and the short-hour group the lowest; economic status was favorable to a lower sickness rate for the long-hour group but the actual rate experienced was highest for these workers.

Two other possible factors of this type are occupational class such as clerical, skilled, and unskilled labor, and the type of work such as light, medium, and heavy. Because of the small numbers of workers observed and also because of the necessity of coding the data in such a way that each month is counted according to the hours worked per week during the major part of that particular month, it was not feasible to consider all of these factors simultaneously. However, it was possible to compare the make-up of the long, medium, and short-hour observation time according to occupational class and according to type of work. Tables 8 and 9 show such comparisons with respect to type of work and occupational class, respectively. In

these tables less detail is shown for women because of the small number of women workers and because few women were doing either heavy or unskilled work.

Considering first Table 8, it is seen that the short-hour working time consisted of 33 per cent on light work, 37 per cent on medium work, and 30 per cent on heavy work as compared with corresponding percentages for the long-hour group of 27 per cent on light work, 37 per cent on medium, and 36 per cent on

Table 8. Distribution of months of observation for each hours-of-work group and occupational class[1] according to type[1] of work as light, medium, or heavy—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Occupational Class and Type of Work	Percentage Distribution				Number of Months of Observation of Workers With Different Hours per Week		
	All Hours	Long Hours	Medium Hours	Hours Short	Long Hours	Medium Hours	Short Hours
	MEN						
All Workers	100	100	100	100	6046	10939	10492
Light Work	32.8	26.6	36.4	32.7	1611	3980	3429
Medium Work	36.5	37.4	35.4	36.9	2262	3877	3874
Heavy Work	30.7	36.0	28.2	30.4	2173	3082	3189
Skilled Workers	100	100	100	100	3047	4502	4166
Light Work	20.4	17.8	21.5	21.2	541	969	882
Medium Work	41.7	38.9	43.3	42.1	1185	1951	1754
Heavy Work	37.9	43.3	35.2	36.7	1321	1582	1530
Unskilled Workers	100	100	100	100	2312	4551	4591
Light Work	20.3	16.6	24.7	17.7	383	1125	812
Medium Work	44.7	46.6	42.3	46.2	1077	1926	2120
Heavy Work	35.0	36.8	33.0	36.1	852	1500	1659
	WOMEN						
All Workers	100	100	100	100	870	4970	5490
Light Work	69.0	59.3	75.5	64.7	516	3750	3552
Other Work	31.0	40.7	24.5	35.3	354	1220	1938
Skilled and Unskilled Workers	100	100	100	100	620	2216	3142
Light Work	41.3	42.9	44.9	38.3	266	996	1204
Other Work	58.7	57.1	55.1	61.7	354	1220	1938

[1] Occupational class and type of work at end of study period; these broad classes did not change greatly between 1941 and 1943.

heavy work. While the proportion of the long-hour workers on light work is not as large as for medium and short-hour workers, the percentages engaged in each type of work are reasonably similar among the three hours-of-work groups. Thus it would not appear that the sickness rates in the different hours-of-work groups would be greatly biased by varying proportions of the workers that were on different types of work.

Referring to Table 9, the clerical workers make up a smaller proportion of the total working time of the long-hour group than is true of either the skilled or the unskilled workers. In the short and medium-hour groups clerical workers account for about 17 per cent of the total, as compared with 11 per cent in the long-hour group. In the short and medium-hour groups

Table 9. Distribution of months of observation for each hours-of-work group and type[1] of work according to broad occupational class[1]—data obtained by monthly canvasses of households in the Eastern Health District of Baltimore, Maryland, 1941–1943.

Type[1] of Work and Occupational Class	Percentage Distribution				Number of Months of Observation		
	All Hours	Long Hours	Medium Hours	Short Hours	Long Hours	Medium Hours	Short Hours
	100	100	100	100	6046	10939	10492
	15.7	11.4	17.2	16.5	687	1886	1735
All Workers	42.6	50.4	41.2	39.7	3047	4502	4166
Clerical	41.7	38.2	41.6	43.8	2312	4551	4591
Skilled	100	100	100	100	1611	3980	3429
Unskilled	47.8	42.6	47.4	50.6	687	1886	1735
Light Work	52.2	57.4	52.6	49.4	924	2094	1694
Clerical	100	100	100	100	2262	3877	3874
Other	48.8	52.4	50.3	45.3	1185	1951	1754
Medium Work	51.2	47.6	49.7	54.7	1077	1926	2120
Skilled	100	100	100	100	2173	3082	3189
Unskilled	52.5	60.8	51.3	48.0	1321	1582	1530
Heavy Work	47.5	39.2	48.7	52.0	852	1500	1659
Skilled	WOMEN						
Unskilled	MEN						
All Workers	100	100	100	100	870	4970	5490
Clerical	47.2	28.7	55.4	42.8	250	2754	2348
Skilled and Unskilled	52.8	71.3	44.6	57.2	620	2216	3142

[1] *See* note on Table 8.

the proportions of the workers who were skilled are, respectively, 40 and 41 per cent, and the proportions who were unskilled are, respectively, 44 and 42 per cent. Corresponding figures for the long-hour group are 50 per cent skilled and 38 per cent unskilled. Thus there is an excess of 9 to 10 per cent of skilled working time in the long-hour groups, which is made up by deficits about equally divided between the clerical and unskilled group. Here again it does not seem that the proportions of workers in the three broad occupational classes are sufficiently dissimilar in the various hours-of-work groups to account for the differences which have been found in illness rates in the several hours-of-work groups.

Summary

A family study of illness in Baltimore afforded an opportunity to compare sickness rates among persons working different hours per week. The workers were scattered in various plants in and near Baltimore; all data were obtained by monthly visits to the family. Employed persons in the households were classified as to weekly hours of work as follows: Long, 50 or more hours; medium, 44–49 hours; and short, 24–43 hours. Unemployed persons and those working less than twenty-four hours per week were not included in the study.

Illness and injuries were tabulated by such types as disabling, confined to bed, and attended by a doctor, and for several broad diagnoses.

Case rates for all causes of illness per 1,000 full-time years of life were generally higher among long than short-hour workers of each sex, although economic status was rather more favorable toward lower rates among long-hour workers (Fig. 1). This general picture was true for workers classified into broad age groups (Fig. 2) and for workers in both defense and nondefense plants (Fig. 3).

Minor respiratory attacks were consistently more frequent in the long than in the short-hour groups (Figs. 4 and 6).

Age differences among the populations of the three groups do

not account for the variation in the rates; nearly all of the data are shown separately for male and female workers.

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PUBLIC HEALTH ASPECTS OF CANCER CONTROL

SAVEL ZIMAND[1]

IT is over thirty-five years since the cancer control movement was launched in this country. But though a number of health departments have for years conducted cancer programs, and in 1937 the Federal Government established the National Cancer Institute, it is only since the close of World War II that public health agencies have begun to regard work in this field as a major responsibility. Under the steady influence of the American Cancer Society and its affiliated branches, it has become increasingly clear to the great body of public health workers that even with our present limited knowledge a great deal can be done to decrease mortality from this disease. The methods to be employed towards this aim are discussed below. But first a few facts on the extent of the problem may be considered.

MORBIDITY AND MORTALITY DATA

No accurate cancer morbidity data are available, for in most states cancer is not a reportable disease. There are, however, informed estimates on the number of cases of cancer in the United States. These are based on a survey made in the years 1937–1939 by Harold F. Dorn, Senior Economist of the United States Public Health Service. Dorn estimated that at any given time during these years there were about 475,000 to 500,000 persons under treatment for cancer. Of this total, about 300,000 new cases were diagnosed for the first time during each year. In addition there are those who have been treated and cured as well as those with undiagnosed malignant tumors. The number in the latter two categories is unknown.

Now as to cancer mortality. In 1900, cancer ranked eighth among the leading causes of death. Its death rate has been steadily increasing, since 1929 cancer has been the second cause of death. In 1900, cancer claimed 40,700 deaths as against about 189,000 in 1947.

There are several important factors that account in part for

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the increases in the recorded cancer deaths. These include: (1) more cancer cases than formerly are now recognized due to greater accuracy in diagnosis; (2) all states are now in the registration area and the cancer mortality statistics are also more accurate due to more faithful reporting of cause; (3) overall increase of the population (from 76,000,000 in 1900 to about 142,000,000 in 1947); and (4) the average length of life of the individual has increased, so more people reach the age at which cancer is most apt to develop. And as has been said, while young men may die, old men must die.

Our population is steadily aging. In 1900, only 18 per cent of the total population was 45 years and older. By 1944 this had risen to 27 per cent. Since 90 per cent of all cancer deaths occur in this age group, this aging of our population has contributed greatly to the rise in the cancer mortality.

While in 1900 the cancer mortality rate was 64 per 100,000, in 1940 it was 120. However, in 1940, the cancer death rate adjusted to age distribution of the year 1900 was only 80.3. The Statistical Service of the Metropolitan Life Insurance Company estimates that about 70 per cent of the increase in the crude cancer death rate observed since 1900 can be attributed to the changes in age characteristics of the population.

This raises the all-important question whether, once correction has been made for our aging population, an individual of a certain sex and age is more likely to die of cancer now than such an individual used to be. Figures compiled recently by the American Cancer Society indicate that during the period 1936–1945, the cancer death rate did not increase among women, if corrections were made for the aging population. In fact, there appears to be a very slight decrease, the reductions occurring in the age group 45–74. Among men, not only does cancer cause more deaths in the older age group, but it is responsible for an ever increasing proportion of all deaths. (One in 80 for men under 20 and one in 8 for men over 40.) Among women, however, cancer deaths reach a peak in the ages 40 to 60, when over one death in four is due to cancer.

It is well to point out that, according to estimates made by Harold F. Dorn, about 34 per cent of all patients in whom a diagnosis of cancer is made die within one year. Add to this however, that while a large percentage of persons with cancer of the digestive and respiratory systems die within one year of diagnosis (not onset of the disease), five-year survival rates among patients treated for early accessible cancers, such as the breast, lip, skin, are much more favorable—about 75 per cent for cancer of the breast and 95 per cent for cancer of the skin. This reflects not only the results achieved by early diagnosis and competent treatment, but indicates their importance as the most promising method in the anti-cancer campaign at this time.

Objectives of Cancer Control Program

1. One of the most obvious objectives in cancer control programs is *popular instruction.* It's aim is to familiarize the public with a few essential facts in order to secure rational action and to allay unfounded fears. Catchy slogans, which cannot be substantiated, should be avoided. This does not eliminate the necessity of presenting the facts with the most effective technique, as to selection of content and form.

A discerning educational approach is necessary if we are to reach the state of motivation where knowledge means action and results in a greater reduction of cancer mortality. Neither can cancer instruction of the laity be limited to a week or a month a year. Education demands continuous year-around activity by specific media and personal contacts which carry a specific message for a specific group and is designed to make them act. The methods to be employed have to be worked out by personal contact and the type of materials to be used have to be chosen in the light of personal needs.

Much cancer education is now being carried on. To give one example, during 1947 the New York City Cancer Committee provided educational programs for twenty meetings a week, and had more than twenty-six film showings a week. But more

intensive activities are necessary even in places where a great deal of educational work is already being conducted. And the educational program must have the active interest and participation of the community.

2. *Education for Medical Students.* No public health program has ever been successful without a well-planned program of professional education. Teachers at medical schools and others have repeatedly pointed out the need for adequate integrated teaching of medical students in diagnosis, prevention and treatment of cancer. Physicians and surgeons active in the cancer control movement also are emphasizing constantly the necessity of periodic refresher courses, and programs to bring newer cancer knowledge to physicians as it is acquired. The United States Public Health Service and the American Cancer Society and its branches are supporting, with special grants, programs for better medical training in the field of cancer.

3. *Adequate Diagnostic and Treatment Facilities.* There are now in the United States over 400 cancer diagnostic and treatment clinics approved by the American College of Surgeons. In addition, many hospitals throughout the country, while not conducting tumor clinics, take care of cancer patients in other appropriate departments. There should be a nation-wide survey of available facilities to determine the needs for increased and improved facilities. But even present data indicate a lack of adequate facilities in some parts of the country, and communities should act promptly to meet this need.

4. *The Cancer Detection Center.* These centers, of which there are now about 250 in the United States, represent a newer development in the cancer control field and are still in the experimental stages. They furnish physical examinations for apparently well individuals and are public-health tools for the discovery of cases in the earliest stages.

It has been found that, in general, such preventive and detection services in other public health fields serve to decrease morbidity and improve the health of the population. But in the case of a disease such as cancer, where there is no definite

knowledge of the cause of the disease and no specific approved test to determine its presence, the effectiveness of detection centers must be based on the number of cancer cases in early curable stages brought to light which otherwise would remain undiscovered and upon the discovery of conditions which are recognized as predisposing to cancer.

Only a thorough evaluation, with the help of accurate data on cure rates of different types of cancer in different age groups, can determine to what extent they accomplish this aim and whether they need modification. But even now one point is obvious. We shall never have enough such centers to take care of the entire adult population. It is therefore important to encourage practicing physicians to conduct cancer detection examinations similar to those given at the centers. This may require a carefully planned educational program for physicians (symposia, institutes, post-graduate courses, etc.), and education by physicians of their patients.

5. *Hospital Facilities.* It is unnecessary to add that no cancer control program can function effectively without adequate hospital facilities, and that the availability of sufficient hospital beds for cancer cases depends to a large extent on the adequacy of the number of beds available for all sick requiring hospitalization. From the data on hand it is difficult to state to what extent the need for hospitalization of cancer cases is being met now.

6. *Home Care of Advanced Cancer Patients.* While a public health cancer control program is mainly built about the principle of finding cases early in order to increase the cure rate, the advanced cancer cases—in the main a welfare rather than a public health problem—cannot be neglected in the organization of cancer services. It is well known that institutional facilities for the care of indigent advanced cancer patients, as well as for all chronically ill, are inadequate. At the same time it is recognized by many experts that many advanced cancer patients can be satisfactorily taken care of in their own home provided they can have medical supervision and nursing service as

needed. This would also free hospital beds for those in need of hospitalization.

The New York City Cancer Committee has made an arrangement with Montefiore Hospital which provides a constructive program for the care of such patients in their homes. This program has now been financed by the New York City Cancer Committee for nearly two years. It has proved to be a most worthwhile and effective service, and points the way for further organization of such services. Based on the above demonstration, other organizations are now experimenting with similar projects for other types of chronically ill patients.

7. *Morbidity Reporting.* The American Public Health Association at its 1946 annual meeting passed a resolution urging health departments to make cancer a reportable disease. Cancer is now a reportable disease by law in about half the states. However, there are only two or three in which a serious attempt has been made to encourage complete reporting.

Certain other states, especially Connecticut, have what is known as a Central Tumor Registry and the reporting is done only through the hospitals. Hospitals are rated on a merit system and those which send in the greatest number of reports with biopsies and similar data receive a proportionately larger share of funds from the state health department for cancer research or the increase of cancer facilities. There is no general agreement as to whether the reporting from hospitals alone is sufficient or whether a central registry on a voluntary basis could be established which would include also the cases from private physicians. At any rate, it is essential to have a recording system to aid in the scientific study of cancer, to make possible a more intelligent public understanding of the essential facts of the disease, and to assist in planning and carrying out sound cancer control activities. To this end, the American Cancer Society and the United States Public Health Service are offering assistance to health departments.

8. *Support of Cancer Research and for Increasing the Number of Experts in Research.* This point is mentioned last merely

for purposes of emphasis, for the cancer problem can never really be conquered until the cause is known and the cure found. We need increased funds for research, but we also need support for the thorough training of capable investigators. Without enough trained investigators, we would be in the position of a cook asked to prepare a wedding feast for which the champagne had been furnished but no water to boil the potatoes, to borrow a simile used by Dr. Raymond B. Fosdick.

The American Cancer Society

Mention should be made of the support given to research by the American Cancer Society and its affiliated branches. During the past two and a half years, the American Cancer Society has coordinated its research program on a nationwide scale under the scientific and technical guidance of the Committee on Growth of the National Research Council. In the past, public and private money may have been wasted because there was no way of finding out whether a particular phase of research was duplicating efforts already made. It might happen that a scientist started work along the very line that another scientific worker, in another part of the country, had already investigated and found a blind alley. Under the present system, such duplication and waste is avoided. Grants for research are approved only after the leading men composing the various panels of the Committee on Growth have satisfied themselves as to the importance of the proposed project.

Since its organization in 1913, the aims and objectives of the American Cancer Society have been enlarged and its program has been broadened so as to include many new projects, such as substantial aid to hospitals and clinics for developing cancer detection centers and cancer diagnosis and treatment clinics; fellowships in cancer research; better medical training in the field of cancer; service for advanced cancer patients; expansion of educational and informational services and innumerable other constructive activities. The Society has encouraged state and city public health departments and the Federal Government to develop an interest in cancer control and has stimulated

medical societies to form cancer committees. It has helped the American College of Surgeons' program for minimum standards for cancer clinics.

Federal and State Projects

As already mentioned, public health agencies are now giving special and increased consideration to cancer control. In 1946, Congress made available $2,500,000 to the states for grants in aid for cancer control activities. For the fiscal year 1947–1948, the cancer appropriation by Congress amounted to $14,000,000 of which approximately 40 per cent was allocated for cancer control work, with the remainder going into research. Dr. Leonard A. Scheele pointed out last year, that the number of full-time people in state health department cancer control programs would reach 200 by the end of June, 1948, compared with one-half this number a year previously. All this is evidence of the greatly increased interest of official health agencies and their greater acceptance of obligations to participate in cancer control. In addition to the funds allocated by the Federal Government, quite a number of state and city health departments are supporting cancer control activities with their own money and others are about to undertake them.

Although compared with only a few years ago, a tremendous amount of effort and money is now going into cancer control, a great deal more must be done. Individual features of the program need careful evaluation. Only by conducting the work on a sound scientific basis and by making the maximum use of the methods now available can we hope to substantially reduce cancer mortality. But not until science furnishes us with specific tests for its early detection can we really hope to control cancer in the same way that tuberculosis has been controlled. Thus the attack must continue to be a twofold one: maximum use of available methods and research for new methods. And it is obvious that this work cannot be conducted with greatest effectiveness by the special effort of any one group. There must be integration of effort of all organizations and individuals working in this field.

ANNOTATIONS

VACCINATION AGAINST EPIDEMIC INFLUENZA IN MAN

THE present status of vaccination against epidemic influenza, of the results so far obtained, and a discussion of the problems which still remain unsolved are presented clearly and concisely in Dr. F. G. Blake's article "An Evaluation of Vaccination Against Epidemic Influenza in Man."[1]

A brief survey describes the research work done in recent years on the problem of influenza vaccination and discusses some of the literature available on this subject. Starting with 1933, the year of the initial demonstration that a filtrable virus in the throat washings of patients with influenza could be transmitted to ferrets and that the serum of recovered ferrets and convalescent humans could neutralize the infecting capacity of the virus, Blake points out the most important steps in the study of the influenza virus with full reference to the original publications.

The development in the preparation of a more effective vaccine which has taken place during the last five years is described. By 1941, even though no satisfactory immunizing agent against influenza A had been found, yet the reduction in incidence observed in certain experiments was not negligible. At this time a complex chicken embryo-influenza A and canine distemper vaccine was used by Horsfall, *et al.*[2] on volunteers in a number of state institutions; laboratory tests showed that it stimulated the formation of considerable quantities of neutralizing antibodies against the influenza A virus. A study of

[1] Blake, Francis G.: An Evaluation of Vaccination Against Epidemic Influenza in Man. *Bulletin of the New York Academy of Medicine*, May, 1948, 24, p. 308.

[2] Horsfall, F. L., Jr.; Lennette, E. H.; Rickard, E. R.; and Hirst, G. K.: Studies on the Efficacy of a Complex Vaccine Against Influenza A. *Public Health Reports*, September 19, 1941. 56, No. 38, pp. 1863–1875.

the incidence of influenza in the epidemic which occurred four months after vaccination showed the following results: In four of the institutions where a weaker strain of the vaccine had been used there were 19 per cent fewer cases of influenza A among the vaccinated group than among the control group of same size, whereas in six other institutions there were 50 per cent fewer cases in the vaccinated group. These results also tended to confirm the theory that a high potency vaccine able to increase specific antibodies to even higher levels might effect more striking reductions in the incidence of influenza.

Attempts, therefore, followed to develop a more potent vaccine by further concentration of the virus. The new vaccines were to be tested during an epidemic expected in 1942–1943 which, however, failed to occur. Observations could, therefore, only be conducted on the protective effect of the vaccine against experimentally induced influenza A and B. In a controlled study at the Ypsilanti State Hospital in Michigan it was demonstrated that the vaccine had a significant protective effect against induced influenza A and B.

During the winter of 1943–1944 a well-controlled investigation of the prophylactic effect of influenza vaccination was carried out by the Commission on Influenza in Army Student Training Program Units in nine universities throughout the country. The students in all Units were about evenly divided into vaccinated and control groups and a considerable epidemic of influenza A appeared in all Units. Vaccination given subcutaneously shortly before or, in some cases, even after the onset of the epidemic, was found to exert a protective effect with a total attack rate of 2.22 per cent among 6,263 vaccinated persons and a rate of 7.11 per cent among 6,211 controls.

In order next to determine the effect of vaccine on influenza B, an expected outbreak of which occurred in November and December, 1945, a controlled study was conducted at the University of Michigan. It was found that in an Army Unit of 600 men vaccinated with concentrated influenza A and B vaccines, prepared from infected allantoic fluid, the incidence was 1.15 per cent, whereas in a comparable Service Unit of 1,100 men who were not vaccinated, the rate was 9.91 per cent. The evidence clearly indicated that the vaccine exerted a striking pro-

tective effect. Analogous studies made about the same time in other universities, in the Army, and in industrial groups helped to substantiate, in general, these same findings.

Blake summarizes the main prerequisites of success as follows:

> . . . . (1) when a potent formalinized and concentrated vaccine, in a single dose of 1.0 cc. subcutaneously and capable of stimulating an antibody response comparable to that which develops early in convalescence, was used; (2) when the antigenic structure of the strains of virus used in the vaccine was closely similar to that of the strains causing the epidemics; and (3) when vaccination had been carried out within one to six weeks prior to the onset of the epidemic.

When, however, one or more of these conditions is lacking, vaccination is not successful. For instance, during the winter of 1946–1947, large-scale vaccinations at the University of Michigan had very little effect due to the sharp antigenic deviation of the strains in the vaccine from the prevalent epidemic strain. Moreover, in this instance, the epidemic occurred only four months after vaccination.

Despite the considerable success which has attended the recent development of vaccination against influenza A and B, Blake points out that many requirements will still have to be met before the completion of a universally effective vaccine. It will be necessary to achieve maximum antigenic effectiveness through proper concentration while avoiding excess toxicity; another aim that should be kept in mind is the reduction of the amount of egg protein for reasons of allergy and the achievement of an economic method of preparation in view of the mass production of the vaccine. Also, experiments which are now being conducted will have to determine the most successful dosage to be used which is expected to be less than the currently used 1.0 cc. As to the time and frequency of the vaccination, it appears tentatively that vaccination in fall and at yearly intervals promises the best results and that the vaccine used should contain both A and B types of virus and in each the most prevalent strains encountered in recent epidemics.

MAGDA POLLACZEK

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TO TITLES OF ARTICLES AND AUTHORS IN THE MILBANK MEMORIAL FUND QUARTERLY

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